RESULTS AND DISCUSSION

4. Results and Discussion

The present investigation was undertaken to study the “Composition of processed foods, status of food labeling and its utility towards healthy food choices.” This chapter presents the results and their discussions in four phases as mentioned in the “Chapter 3: Materials and Methods.” The Phase-I of the present study was “Situational Analysis-Processed Food Consumption among the Consumers.”

Phase I: Situational Analysis-Processed Packaged Food Consumption among the Consumers

The situational analysis was carried out to extract information on frequency and quantity of processed packaged foods consumed by the subjects aged ≥15 years from Urban Vadodara. A total of 807 subjects were enrolled and they were categorized according to gender and age groups. Semi-quantitative food frequency questionnaire was used to elicit the information on brands, frequency and quantity of consumption of processed packaged foods. The demographic information namely, age, gender, education, profession, family income, profession, marital status, height, weight, medical condition, allergy (if any) and family type was also collected with the help of semi-structured questionnaire as given in Annexure II.

Demographic Profile of the Consumers

To study the demographic features, the consumers were segregated by gender and age. Table 4.1.1 details the socio-demographic profile of the consumers. It can be seen that 62% of the consumers were female and 38% were males. Of the total population, majority of the consumers (43%) belonged to the adolescent age-group (Male=16.7%, Female=26.3%) followed by 38.3% adults (Male=12.3%, Female=26%) and 18.7% elderly (Male=9.4%, Female=9.3%). A majority of consumers (66.6%) had education upto higher secondary, followed by graduation (18.6%) and post-graduation (14.7%). Profession-wise, 26.6% of the consumers were school students, 25.3% were college students, 18.3% were housewives, 9.4% were government employees, 7.1% were retired, 6.9% were working in private firms and 6.3% were self employed. Majority of the consumers were living in nuclear families (56.9%), followed by joint families (40%) and few were singles (3.1%).

Table 4.1.1: Socio-demographic Profile of the Consumers

Socio- Demographic Parameters	Categories	Frequency	Percentage
Adolescents (≤19 years)	Male	135	16.7
	Female	212	26.3
Adults (20-59 years)	Male	99	12.3
	Female	210	26
Elderly(60 years and above)	Male	76	9.4
	Female	75	9.3
Educational Qualification	Upto Higher Secondary	538	66.6
	Graduation	150	18.6
	Post Graduation	119	14.7
Profession	School Student	215	26.6
	College Student	204	25.3
	Government Job	76	9.4
	Private Job	56	6.9
	Self Employed	51	6.3
	Retired	57	7.1
	Housewife	148	18.3
Family Type	Singles	25	3.1
	Nuclear Family	459	56.9
	Joint Family	323	40

Table 4.1.2 Medical Condition and Food Allergy among the Study Population

Parameters	Responses	Frequency	Percentage
Medical Condition	Yes	92	11.4
	No	715	88.6
Food Allergy	Yes	32	4
	No	775	96

Table 4.1.2 shows that 11.4% of the consumers had medical conditions like diabetes, hypertension, osteoporosis, thyroid dysfunction, anaemia, asthma, arthritis, kidney stones, digestive tract ailments etc. Of those subjects with medical conditions (n=92),

53% were adults, 40% were elderly and 7% were adolescents. Medical problems were more prevalent among females (68%) as compared to males (32%). It was also observed that most of the consumers with medical conditions were obese (n=59, 64%) and overweight (n=13, 14%) while few fell in the category of normal (n=16, 17%) and underweight (n=7, 4%).Therefore, increased weight can be the cause of medical conditions. Of the total population, 4% of the consumers reported of having food allergies. Food allergies were related to milk and milk products, fermented foods, almonds, groundnuts, egg and prawns.

Figure 4.1.1: Distribution of Consumers with respect to Body Mass Index (BMI)and Age-group Categories According to Asia Pacific Criteria, 2004(in percentage)

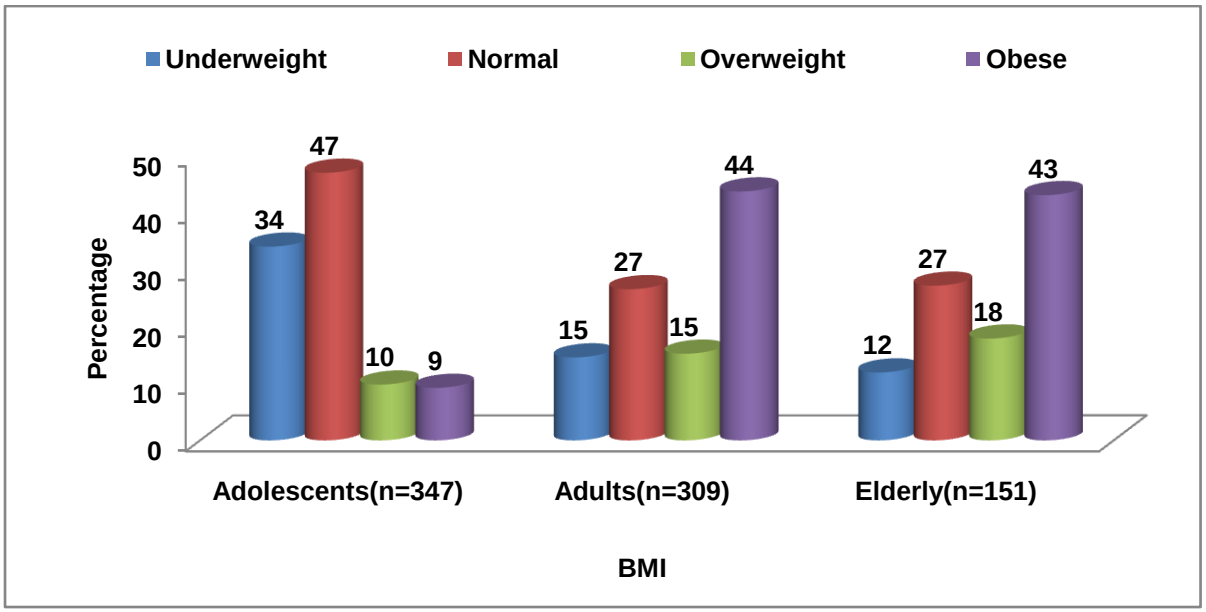


Figure 4.1.1 illustrates distribution of the study population with respect to BMI and age-groupsas per Asia Pacific Criteria, 2004. Majority (35.4%) of the consumers had normal BMI, 28.7% were obese, 22.4% were underweight and 13.4% were overweight. As age increased, overweight and obesity increased. A positive correlation between age and BMI was observed and it was statistically significant at p≤0.01 (r=0.375, n=807, p≤0.01).

Processed Packaged Food Consumption

The consumers were interviewed to gather information on variety and amount of processed packaged foods commonly consumed by them and the results of the same have been presented hereafter.

Figure 4.1.2: Most Popular Processed Packaged Foods Consumed by the Consumers from Various Food Categories (in percentage)

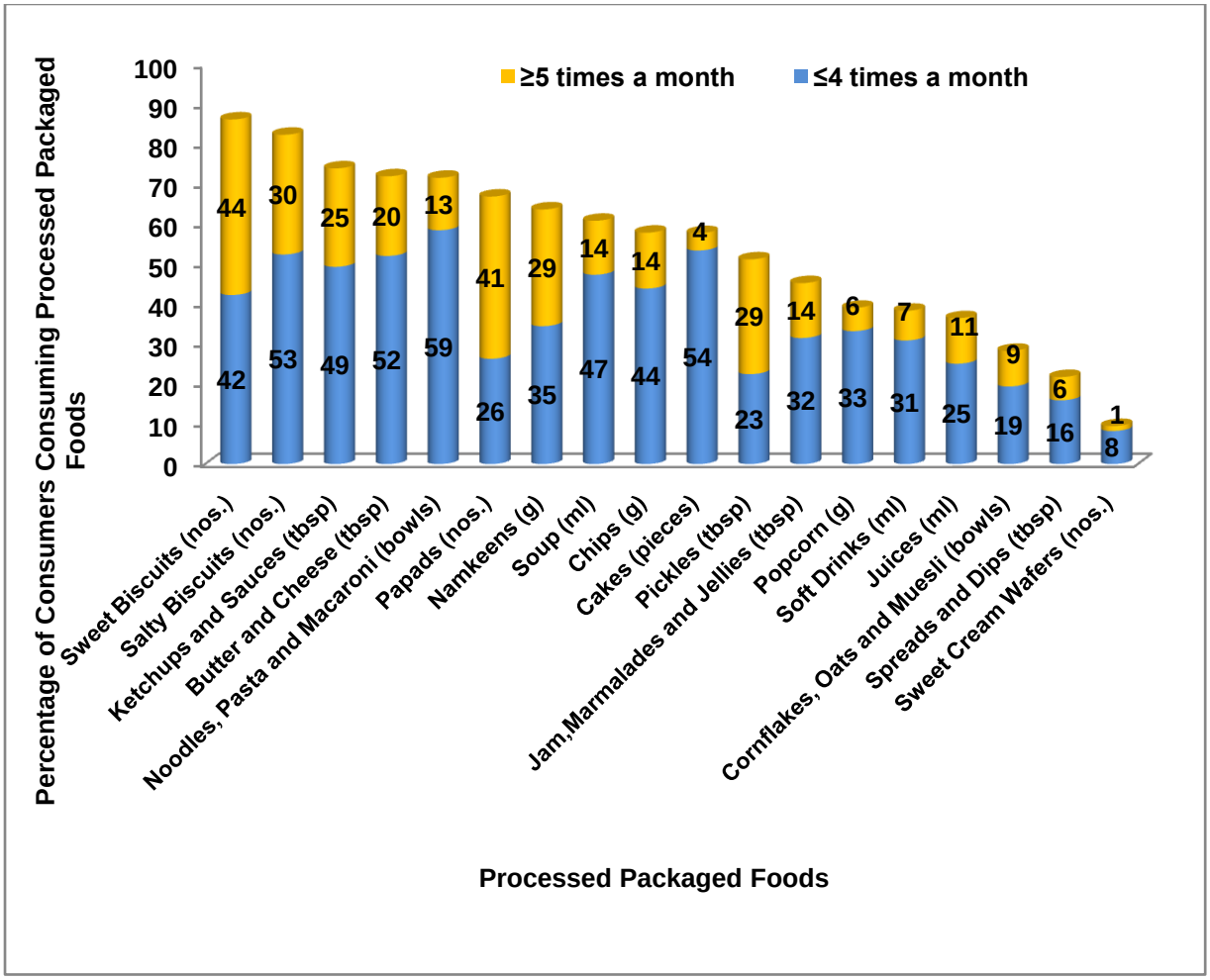


Figure 4.1.2 show that the most popular food in the studied population was sweet biscuits and it was consumed by 86% of the consumers. The consumption of sweet biscuits was followed by salty biscuits (83%), ketchups and sauces (74%), butter and cheese (72%), noodles, pasta and macaroni (72%), papads (67%), namkeens and savories (64%), soups (61%), chips (58%), cakes (58%), pickles (51%) and the remaining processed packaged foods were most commonly consumed by less than 50% of the subjects. The figure also illustrate the percentage frequency of each processed packaged foods consumed by the consumers. It can be seen from the figure that sweet biscuits were consumed "≥5 times a month" by 44% of the consumers and 42% of the consumers consumed the same less frequently i.e. ≤4 times a month. Similarly, papads were consumed "≥5 times a month" by 41% of the

consumers and "≤4 times a month" by 26% of the consumers. The frequency of consumption of processed packaged foods in the present study was lower than the similar products studied by Chandorkar and Shah (2014). The lower frequency of processed food consumption in the present study may be due to the difference in the age-groups taken in the study. In the present study, subjects belonged to the age group of ≥15 years, while in study by Chandorkar and Shah, the subjects were adolescents. The other food products that were popular among adolescents were pani puri (82%), ice cream (81%), butter puff (80%), samosa (69%), wafers (77%), fresh juice (62%), bread slice (57%), veg roll (57%), ratlami sev (52%), kurkure (50%), aloo sev (46%), banana chips (43%), cheetos (40%), bhujiya sev (37%), khaari (32%), salty biscuits (32%) and maakhanya (local salted bakery product) (32%), fryams (30%), brownie (19%), jalebi (19%), samosa sandwich (19%), rasgulla (17%), sandwich (13%) and subway (11%). Another study carried out in Vadodara, Gujarat showed that all young adults consumed butter and noodles followed by sweet biscuits (85%), ketchups/sauces (80%), carbonated beverages (73%), chips (73%) and salty biscuits (70%). Fewer number of study subjects consumed soups (23%), macaroni/pasta (25%), cheese spreads (30%) and jam (35%). More number of adults reported consuming jam as compared to young adults (48% versus 35%). Fewer number of adults consumed chips (6%), cream biscuits (8%), non-carbonated beverages, noodles, pasta and cake (10%) as compared to young adults. Ninety percent of the geriatric subjects reported consuming namkeen, 60% and 40% of the geriatric subjects reported consuming sweet biscuits and butter respectively, while very few/none of the subjects reported consuming other varieties for processed foods (Chandorkar and Joshi, 2012). Most commonly consumed processed foods by individuals aged 2 years and above in US were soft drinks, coffee, tea, ready to eat cereal, margarine, mayonnaise, chicken, macaroni and cheese and pizza (Wright et. al, 2003).

The most popular brands of each food among the consumers have been listed in Table 4.1.3.

Table 4.1.3: Popular Brands of Processed Packaged Foods Consumed by the Consumers in the Present Study

S.No.	Food Categories	Brands
1	**Cornflakes, Oats and Muesli**	Kellog's, Mohan's, Quaker, Saffola, Bagrry's
2	**Noodles, Pasta and Macaroni**	Maggi, Top Ramen, Sunfeast Yipee, Disnep, Ching's, Knorr, Horlicks, Bambino, Blue Bird, Delmonte,
3	**Salty Biscuits**	Sunfeast Snacky, Parle Monaco, Windsor
4	**Sweet Biscuits**	20-20, Britannia, Parle G, Tiger, Milk Bikis, Britannia Gooday, Hide and Seek, Britannia, Winsor, Oreo, Dark Fantasy
5	**Sweet Cream Wafers**	Pickwick, Gourmet's, Waffy, Dukes, Tiffany
6	**Cakes**	Britannia, Monginis
7	**Jam, Marmalades and Jellies**	Kissan, Mala's, Spencer, Mapro, Tops, Sil, Tasty Treat
8	**Butter and Cheese**	Amul, Britannia
9	**Spreads and Dips**	American Garden, Fun Foods, Sam's, Smith and Jones, Kraft's, Amul, Britannia, Gowardhan
10	**Juices**	Tropicana, Real, Onjus, Mapro
11	**Soft Drinks**	Minute Maid, Appy, Slice, Frooti, Maaza, Coca-Cola, Pepsi, Thumps Up, Mountain Dew, Fanta, Mirinda, Sprite
12	**Soups**	Knorr, Ching's, Maggi, Tasty Treat, MTR
13	**Ketchup and Sauces**	Kissan, Maggi, Delmonte, Heinz, riya, Smith and Jones, Tops
14	**Pickles**	Nilon's , Mother's Recipe, Ankur, Ashoka, Everest, Delmonte, Priya, Real, Shreeji, Smith and Jones
15	**Papads**	Lijjat, Yash, Shreeji
16	**Namkeens and Savories**	Haldiram's, Real, Balaji, Everest, Bikaji, Samrat, Lehar
17	**Potato Chips**	Balaji, Lays, Real, Haldiram's, Uncle Chips, Parle, Bingo
18	**Popcorn**	Act II, American Garden, Popitas

Table 4.1.3 show the most commonly consumed processed packaged food brands by the consumers in the present study. Similar brands of the products were found to be consumed in a study carried out in Vadodara by Chandorkar and Joshi (2012). It was reported that most commonly consumed biscuits were Parle G, Parle Monaco, Britannia Gooday, Marie, Hide and seek, Sunfeast dark fantasy and Bourbon. Jams of only Kissan brand were consumed while for ketchups the most common brands consumed were Kissan, Maggi, Smith and Jones and Cremica. Nutrilite butter was less preferred by the subjects as compared to the Amul butter. Most commonly consumed brand for noodles was Maggi and for Namkeens the brands were Balaji and Haldiram's. Tropicana and Real for juices and Lijjat, Yash and Shreeji for papads were the most common brands consumed by the subjects.

The mean monthly consumption of the processed packaged foods among the consumers was also estimated. The data presented in the following section report the mean monthly consumption by those consumers who consumed the processed packaged foods more frequently i.e. ≥5 times a month.

Table 4.1.4: Mean Monthly Consumption of Processed Packaged Foods among Consumers by Gender and Age-groups

Food Categories	Adolescent Boys	Adolescent Girls	Adult Males	Adult Females	Elderly Males	Elderly Females
	Mean±SD (n)	Mean±SD (n)	Mean±SD (n)	Mean±SD (n)	Mean±SD (n)	Mean±SD (n)
Cornflakes, Oats and Muesli (bowls)	12±4 (20)	13±4 (18)	13±7 (8)	10±4 (18)	10±0 (6)	10±0 (2)
Noodles, Pasta and Macaroni (bowls)	17±9 (39)	16±9 (43)	12±6 (9)	11±5 (14)	6 (1)	–
Salty Biscuits (nos.)	86±57 (44)	68±47 (61)	80±57 (20)	69±59 (62)	63±52 (18)	62±53 (37)
Sweet Biscuits (nos.)	50±42 [a,b] (86)	43±30 [c] (117)	54±53 [d,e] (38)	41±36 (72)	20±12 [a,d] (21)	18±10 [b,c,e] (21)
Sweet Cream Wafers (nos.)	36 (1)	51±24 (9)	–	–	–	–
Cakes (pieces)	47±37 (11)	48±55 (18)	60 (1)	22±15 (5)	–	–
Jam, Marmalades and Jellies (tbsp)	48±32 [a] (37)	44±34 (48)	42±25 (2)	27±15 (13)	12±0 [a] (9)	12±0 (2)
Butter and Cheese (tbsp)	43±30 (57)	41±27 (54)	38±21 (17)	30±21 (26)	52±15 (6)	60 (1)
Spreads and Dips (tbsp)	19±9 (16)	23±16 (28)	16±6 (2)	33 (1)	–	–
Juices (ml)	4118±1982 (17)	4117±2439 (40)	2733±1241 (9)	3982±1940 (11)	2960±2245 (12)	2960±2633 (3)
Soft Drinks (ml)	2444±976 [a] (16)	1789±586 (9)	1767±901 (18)	2042±695 (12)	–	1200±0 [a] (5)
Soup (ml)	2849±983 (20)	2538±1654 (21)	2864±1019 (9)	2016±1119 (33)	2350±658 (12)	2257±199 (14)
Ketchups and Sauces (tbsp)	61±40 [a,b] (44)	53±32 [c] (77)	46±15 (18)	40±29 [a] (40)	26±7 [b,c] (16)	24±0 (4)
Pickles (tbsp)	23±27 [a,b] (41)	17±12 (60)	13±8 [a] (32)	13±8 [b] (65)	12±5 (19)	21±6 (15)
Papads (nos.)	35±18 [a,b] (58)	30±16 (83)	25±22 [c] (56)	22±15 [a,d] (76)	21±21 [b,e] (29)	44±39 [c,d,e] (26)
Namkeens and Savories (g)	865±445 (43)	849±398 (54)	766±487 (34)	720±449 (53)	582±303 [a] (26)	965±478 [a] (26)
Chips (g)	1133±570 (33)	1070±832 (45)	1031±609 (11)	796±417 (16)	997±1061 (3)	660±0 (5)
Popcorn (g)	868±406 (12)	701±412 (23)	340±208 (4)	440±243 (8)	–	–

Note: *Figures in parenthesis denote number of subjects consuming processed packaged foods.*

Super-script ([a,b,c,d,e]) denotes significant difference between groups at p≤0.05 significant level.

Table 4.1.4 itemizes the mean monthly consumption of processed packaged foods among the study population. Mean monthly processed packaged food consumption

was found to be higher in males than females for salty biscuits, sweet biscuits, cornflakes, oats and muesli, jam, marmalades and jellies, ketchups and sauces, butter and cheese, noodles, pasta and macaroni, soups, cakes, pickles, chips, popcorn and soft drinks. Mean monthly consumption of sweet cream wafers, spreads and dips, namkeens and savories, papads and juices were found to be higher in females than males. Cornflakes, oats and muesli were found have similar consumption levels in both males and females in adolescent and elderly age-groups.

According to age-groups, adolescents were found to be the major consumers of all processed packaged foods except for “butter and cheese” and “spreads and dips” which was found to be consumed by elderly and adults, respectively. Compared to the results of the present study, a study carried out by Chandorkar and Joshi (2012) among young adults (18-25 years), adults (26-60 years) and geriatrics (60 years and above) in Vadodara revealed that the mean consumption of processed foods per month was significantly higher amongst young adults than in adults and geriatrics group.

Gender variation in popularity of the processed packaged foods showed that more females than males consumed processed foods. Age-group comparison reflected that majority of the processed packaged foods were popular among adolescents than adults and elderly. Adolescents were the major consumers of all kinds of processed packaged foods. Though the mean consumption of “butter and cheese” and “spreads and dips” was lower in adolescents than adults, but the number of adolescents consuming the same was more than the adults.

Analysis of variance (ANOVA) and multiple comparisons showed a significant difference (at 0.05 significant level) in the mean consumption of products from food categories namely, sweet biscuits, jam, marmalades and jellies, soft drinks, ketchups and sauces, pickles, papads, namkeens and savories and popcorn among various age-groups and gender. Therefore, in order to know which groups differed significantly, the data were further subjected to independent t-test. Table 4.1.4 also show that the significant difference was observed in the consumption of sweet biscuits, jam, marmalades and jellies, soft drinks, ketchups and sauces, pickles, papads and namkeens and savories between different age and gender groups. It can be seen that mean consumption of sweet biscuits differed significantly between

adolescent boys and elderly males, adolescent boys and elderly females, adolescent girls and elderly females, adult males and elderly males, adult males and elderly females. Similarly, significant differences in the mean consumption of jam, marmalades and jellies, soft drinks, ketchups and sauces, pickles, papads and namkeen and savories were also observed.Other socio-demographic factors such as educational qualification, profession and family type showed no uni-directional trends in processed packaged food consumption by the study population.

Similar investigation carried out by Chandorkar and Joshi (2012) from Vadodara revealed that the consumption of jam and ketchups, butter, noodles, papads, chips, juices and soft drinks was significantly higher in young adults (18-25 years) and adults (26 to 60 years) rather than geriatrics (60 years and above). Similar to the present study, there was no significant difference in consumption of soups and macaroni/pasta amongst the three age groups, however namkeen consumption in both the studies was found to be higher in young adults and geriatrics than adults. Butter consumption in both the studies was noticeably higher in geriatrics as compared to young adults and adults.

Table 4.1.5 presents data on the processed packaged food consumption among the consumers suffering from any medical ailments or not. It can be seen from the table that the mean consumption of all the foods were lower in consumers with medical condition as compared to the consumers not having any medical condition except for the soft drinks. The soft drink consumption was higher in consumers with medical condition (2367 ml/ month) as compared to consumers without medical condition (1937 ml/month). Though, there were differences in mean consumption of processed packaged foods in both the groups, yet they did not differ significantly except for the ketchups and sauces ($t=6.685$, $p\leq0.001$).It can be concluded from the table that consumers with medical conditions consumed less of processed packaged foods as compared to the consumers with no medical conditions. This trend could be because of the medical concern, prescription by the doctor and health concerns of the medically unhealthy consumers.

Table 4.1.5: Mean Processed Packaged Food Consumption according to the Presence or Absence of Medical Conditions among the Consumers

Food Categories	Medical Condition-Yes	Medical Condition-No	t- value
	Mean±SD (n)	Mean±SD (n)	
Cornflakes, Oats and Muesli (bowls)	9±1(5)	12±5(67)	1.167
Noodles, Pasta and Macaroni (bowls)	14±12(4)	15±9(102)	0.281
Salty Biscuits (nos.)	63±44(33)	73±56(209)	0.908
Sweet Biscuits (nos.)	31±26(31)	44±38(324)	1.832
Sweet Cream Wafers (nos.)	0	49±23(10)	_
Cakes (pieces)	40(1)	44±45(34)	_
Jam,Marmalades and Jellies (tbsp)	21±12(7)	41±32(104)	1.659
Butter and Cheese (tbsp)	37±24(7)	40±27(154)	0.342
Spreads and Dips (tbsp)	0	21±14(47)	_
Juices (ml)	3493±1973(12)	3819±2242(80)	0.476
Soft Drinks (ml)	2367±451(3)	1937±875(57)	0.84
Soup (ml)	2349±749(16)	2417±1188(93)	0.223
Ketchups and Sauces (tbsp)	30±7(13)	50±33(186)	6.685***
Pickles (tbsp)	13±8(25)	17±15(207)	1.102
Papads (nos.)	24±21(27)	29±21(301)	1.121
Namkeens (g)	747±407(30)	801±446(206)	0.624
Chips (g)	645±30(4)	1040±686(109)	1.146
Popcorn (g)	0	669±402(47)	_

**** significant at 0.001 level*

4.2 Phase II: Market Survey

Market survey of processed packaged foods was carried out in supermarkets (n=4) and grocery stores (n=4) of Vadodara to enlist processed packaged foods across the brands. A total of 1,020 food products were examined for Nutrition Labeling as per the criteria discussed in “Methods and Materials” chapter. The surveyed food products were categorized into 29 food categories and further into 10 food groups based on the major constituting ingredient as given in Table 4.2.1

Table 4.2.1: Food Groups and Food Categories Examined for Nutrition Labeling

S. No.	Food groups	Food categories	Number of Products	Serving Sizes
1	Wheat and oats based products	a. Cornflakes, oats and muesli	46	25-43g
		b. Noodles, pasta and macaroni	66	60-130g
2	Bakery products	a. Salty biscuits	18	_
		b. Sweet biscuits	88	25g
		c. Sweet cream wafers	31	27.4g
3.	Confectionery	a. Chocolates	39	11.4-80g
		b. Cakes	6	_
4	Fruit based products	a. Canned fruits	6	100-140g
		b. Jam, marmalades and jellies	38	2-20g
5	Milk based products	a. Butter and cheese	18	10-32g
		b. Spreads and dips	17	8-20g
6	Drinks	a. Malted beverages	27	20-50g
		b. Soft drinks	13	250 ml
		c. Energy drinks	27	180 ml
		d. Juices	37	200 ml
		e. Squashes	15	_
7	Ready-to-cook/eat products	a. Ready to cook foods	95	50-150g
		b. Ready to use spice mixes	99	7.5-50g
		c. Ready to make cake and ice cream mixes	16	14.29-25g
		d. Ready to eat sweets	27	21-50g
		e. Soups	41	10.5-13.5g or 150-346 ml
8	Food adjuncts	a. Pickles	18	_
		b. Papads	14	20-100g
		c. Chutneys	6	30g
		d. Ketchups and sauces	49	6-100g
9	Snacks	a. Namkeens & savories	107	10-50g
		b. Chips	32	14-20g
		c. Popcorn	10	33g
10	Baby foods	a. Cereal and milk based baby foods	14	20g
TOTAL			1020	-

The results of this phase are presented and discussed under the following heads,

4.2.1: Nutrition Facts Panel

4.2.2: Ingredients List

4.2.3: Allergen Declaration

4.2.4: Health Claims

4.2.5: Nutrient Claims

4.2.6: Ingredients Claims

4.2.7: Symbols and Logos

4.2.8: Manufacture and Best Before Date

4.2.1 Nutrition Facts Panel

Kind of Nutrition Facts Panel (NFP) displayed on Food Labels

According to FSSA of India, 2011, nutrition information on NFP should be given as “per 100 gm” or “100ml” or “per serving” of the product on the label. On the other hand US Food and Drugs Administration (USFDA) mandates that NFP should have information about nutrients in "Amount Per Serving" and "% Daily Value (%DV)", with footnote and caloric conversion information (http://www.fda.gov).

Figure 4.2.1: Kind of Nutrition Facts Panel (NFP) Displayed on Food Labels in Total Products (in percentage)

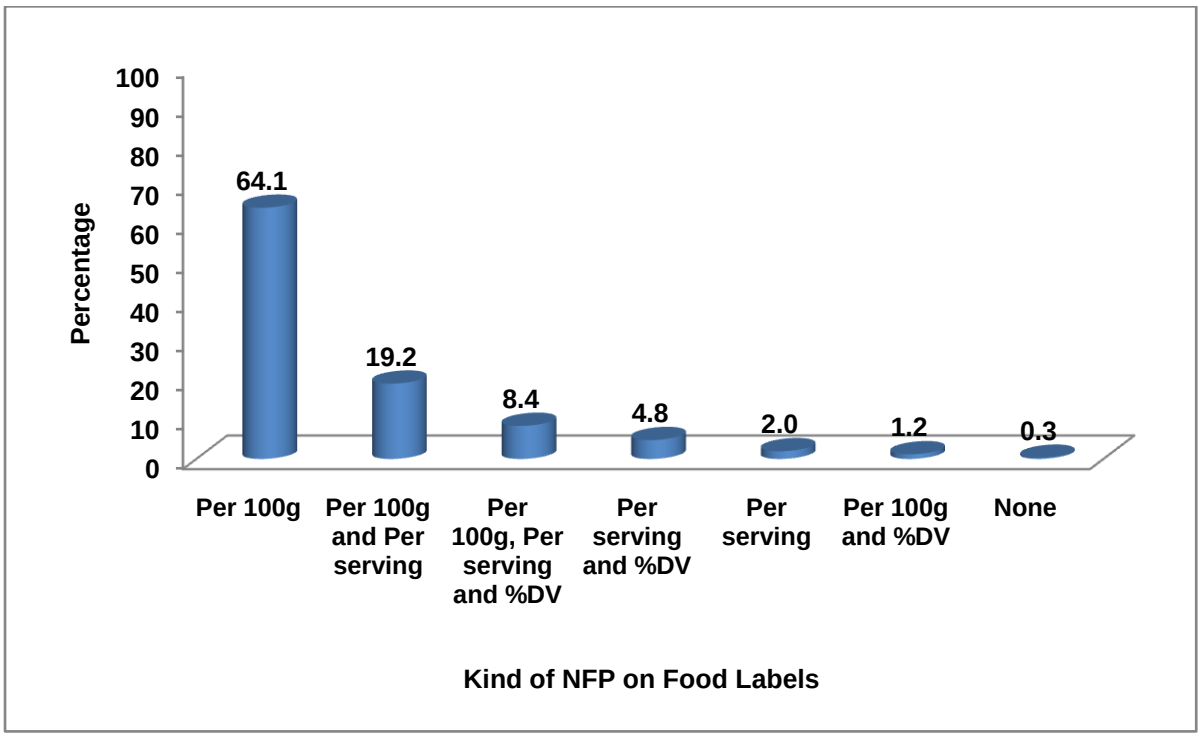


Figure 4.2.1 depicts the kind of NFPs displayed on examined food labels. Majority (64.1%) of food products had NFP as “per 100g.” Unlike %DV NFP the “per 100g” NFP does not have any reference values for nutrients for consumers to compare with and make food choices. In Europe too, most common type of NFP cited on food labels is “per 100 g” (Garsetti et. al, 2007).

Nineteen percent of the products displayed NFP as “per 100g and per serving” and 2% of the products displayed NFP as “per serving.” The advantage of presenting NFP as “per serving” is that it gives the consumers an accurate picture about the healthiness of the food product, provided the serving sizes are realistic and standardized across the brands. Serving size emerge out to be a better reference tool in comparing products of different densities (puffed cereal vs. heavy cereal) or in judging nutritional value of food products that are usually consumed in very small amounts (e.g., butter) (Usmanova and Thor, 2003). However, in the present study inconsistencies in reporting serving sizes was observed among various brands within the same food category making it difficult for the consumers to make healthy food choices. It can be seen from Table 4.2.1 that the serving sizes varied over a large range in all the product categories namely, cornflakes, oats and muesli (25 to 43g), noodles, pasta and macaroni (60 to 130g), chocolates (11.4 to 80g), canned fruits (100 to 140g), jam, marmalades and jellies (2 to 20g), butter and cheese (10 to 32g), spreads and dips (8 to 20g), malted beverages (20 to 50g), ready-to-cook/eat foods (50 to 150g), ready-to-use spice mixes (7.5 to 50g), ready-to-make cake and ice-cream mixes (14.29 to 25g), ready-to-eat sweets (21 to 50g), soups (10.5 to 13.5g and 150 to 346ml), papads (20 to 100g), ketchups and sauces (6 to 100g), namkeens and savories (10 to 50g) and chips (14 to 20g). Food categories namely, sweet biscuits, sweet cream wafers, soft drinks, energy drinks, juices, chutneys, popcorn and milk based baby foods had only one product that reported serving size and therefore the range could not be reported. It can also be observed that none of the products in food categories namely, salty biscuits, cakes, squashes and pickles reported serving sizes. According to FDA, a serving size is a reference amount calculated “for persons 4 years of age or older to reflect the amount of food customarily consumed per eating occasion by persons in this population group” (Code of Federal Regulations, US, 2014).

Only 8.4% of the products reported NFP as “per 100 g, per serving and % DV” and thereby provided complete information and reference values to compare among brands. The %DV helps in determining the nutrient as high or low in a serving of food. Percent DV of “5% or less” is considered to be low and “20% or more” as high. Percent DV for total fat, saturated fat, cholesterol and sodium content is recommended to be “5% or less” while for dietary fiber, vitamin A, vitamin C, calcium

and iron to be “20% or more.” Therefore, %DV makes it easy to make comparisons among products of different brands (http://www.fda.gov). Studies have also shown that compared to NFP in metric units, NFP that declare nutrients in percentage based on reference daily values or %DV are easier to interpret and comprehend (Levy et. al, 1996; Lazaridis and Nayga, 2006).

According to Usmanova and Thor (2003), neither the NFP as “per 100g” nor “per serving” is ideal as a reference unit for labeling. Serving sizes are apt for comparing food products within the same food category while “per 100g” information provides a measure of relative nutrient content which is useful in comparing nutritional characteristics of different products across product categories. A relative content measure helps in the judgment of high or low content of desirable and undesirable nutrients provided the consumer is experienced and educated. Though, “per 100g” information provides relative nutrient content for macronutrients, percent DV is more appropriate for reporting micronutrients namely, cholesterol and sodium. It was also recommended that combination of “%DV and serving size” is more appropriate than “per 100g and serving size.” The reason is, serving size can be used as a reference unit and %DV as magnitude estimation while in “per 100g and serving size” consumers often need to do calculations if they want to find the nutritional value of the food they consume, as these amounts usually differ from 100g or a serving. Therefore, simple, easy to comprehend and understand food labels are preferred by consumers. European countries introduced “Multiple Traffic light label” signposting for 4 major nutrients (namely, fat, saturated fat, sugar and salt) on Front-of-Pack (FOP) which was also tested among various populations. It was found that the presence of “Multiple Traffic light label” on FOP made interpretation for nutrients easy which resulted in healthy food choices by the consumers (Borgmeier and Westenhoefer, 2009). However such attempts have not been made in India.

Figure 4.2.2: Reporting of Mandatory Nutrients on NFP in Total Products (in percentage)

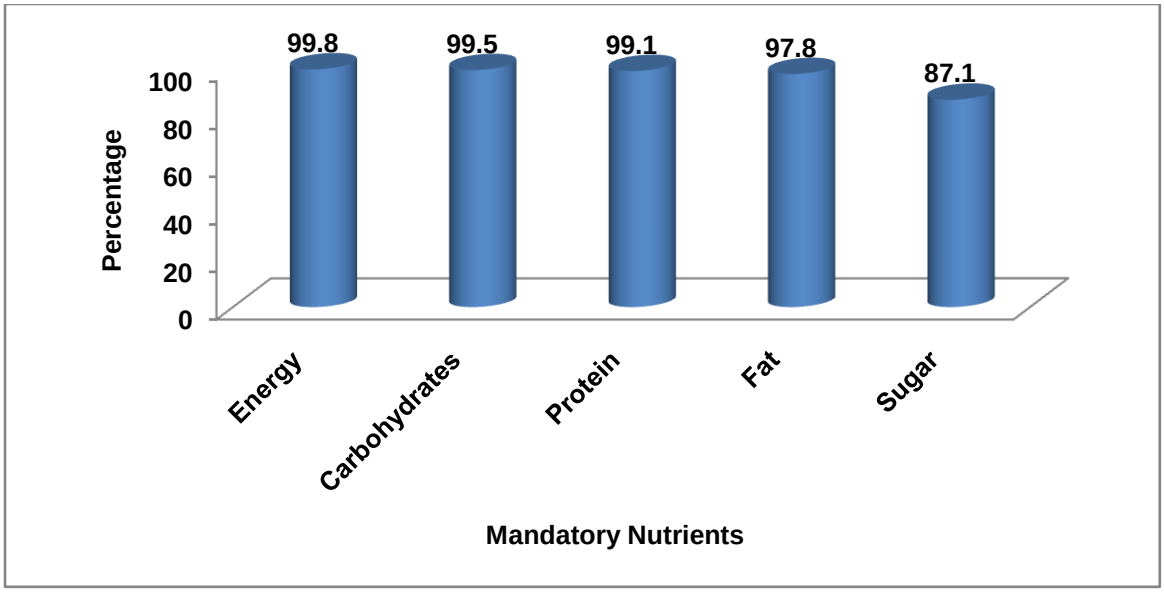


Figure 4.2.2 show the percentage reporting of mandatory nutrients on NFP of the food products. Codex (CAC/GL 2-1985) mandates listing of 7 nutrients on NFP namely, energy, protein, carbohydrates, fat, saturated fat, sodium and total sugars. Beside 7 mandatory nutrients it also necessitates listing of any other nutrient for which a nutrient or health claim is made. Under FSSA it is mandatory to report energy value (kcal), protein (g), carbohydrates (g), sugar (of the total carbohydrates) (g), fat (g or ml) on NFP. Other than these basic five nutrients, if a nutrient or health claim is made then that nutrient should also be reported on the NFP (FSSAI, 2011). Products examined in the present study failed to comply with the same. It was found that energy was reported in 99.8% of the products followed by carbohydrates (99.5%), protein (99.1%), fat (97.8%) and sugar (87.1%). The most significant nutrients of concern namely, fat (97.8%) and sugar (87.1%) complied least. Similar study conducted in China showed that of the total food products with nutrient claims (n=232), the labeling of protein was found in 93.5% of the products followed by fat (87.1%), carbohydrate (86.2%) and energy (84.9%). In the present study, reporting of energy value was higher as compared to the China study where reporting of energy value on the products was lowest. Another observation from the present study shows that 0.2 to 2.2% of the products did not report energy, fat, carbohydrate and protein values while a higher percentage i.e. 7 to 15% of the products from China did not label the same (Tao et. al, 2010). Though the reporting of mandatory nutrients was not optimum in the present study, yet the scenario of labeling mandatory nutrients is better than China.

Table 4.2.2: Reporting of Mandatory Nutrients on NFP in various Food Groups (in percentage)

Food Groups	Energy	Fat	Carbohydrates	Sugar	Protein
Wheat and oats based products	100	99	100	92	100
Bakery products	100	100	100	97	100
Confectionery	100	100	100	100	100
Fruit based products	100	100	100	98	100
Milk based products	100	100	100	89	97
Drinks	100	97	100	81	97
Ready-to-cook/eat products	100	99	99	88	100
Food adjuncts	99	83	98	68	98
Snacks	99	99	99	81	99
Baby Foods	100	100	100	93	100

Table 4.2.2 details the food group-wise reporting of mandatory nutrients as per FSSA. It was found that all the products in "confectionery" reported mandatory nutrients. Snacks and Food adjuncts complied least in reporting of all five mandatory nutrients. It is worth noticing that reporting of sugar did not achieve 100% compliance in 9 out of 10 food-groups. Though, it is mandatory to report basic five nutrients on NFP, yet a majority of the products did not adhere to the same. Due to paucity of data on reporting of mandatory nutrients, the results cannot be discussed further.

Table 4.2.3: Reporting of "Basic 5s", "Other Important 7s" and "Total Number of Nutrients" in various Food Groups (in percentage)

Food Groups	Basic 5s	Other Important 7s	No. of Nutrients
Wheat and oats based products	91	34	5 to 25
Bakery products	97	0	4 to 20
Confectionery	100	0	5 to 12
Fruit based products	98	0	4 to 11
Milk based products	86	6	5 to 15
Drinks	77	0	3 to 42
Ready-to-cook/eat products	86	16	3 to 20
Food adjuncts	54	6	0 to 20
Snacks	81	31	0 to 16
Baby foods	93	0	11 to 38

Table 4.2.3 presents food group-wise data on reporting of “basic 5” (mandatory) nutrients, “other important 7” nutrients namely, Saturated Fatty Acids (SFA), Mono Unsaturated Fatty Acids (MUFA), Poly unsaturated fatty acids (PUFA), Trans Fatty Acids (TFA), Cholesterol, Fiber and Sodium and “total number of nutrients” on NFP. It was found that reporting of basic 5s was adhered to by all the products in only “confectionery.” Ninety eight percent of the fruit based products reported basic fives followed by bakery products (97%), baby foods (93%), wheat and oats based products (91%), milk based products (86%), ready-to-cook/eat products (86%), snacks (81%), drinks (77%) and food adjuncts (54%). This shows that there was poor compliance in reporting “Basic 5s” in 9 out of 10 food groups. The table also show that the number of nutrients reported on food products varied over a large range from 0 to 48 nutrients. In the present study a comparatively higher percentage of products reported fiber, SFA and TFA as compared to a similar investigation carried out in Shanghai, China on 850 pre-packaged foods. The reporting of fiber, SFA and TFA in the present study was 38.3%, 52.5% and 49.2% respectively, while the same was 12.1%, 8.6% and 4.7%, respectively in the food products from China (Tao et. al, 2010).

High-Energy Density and High Fat Foods as per United States Food and Drugs Administration (US-FDA)Criteria

Due to the unavailability of recommendations by Indian Food Laws i.e. FSSA, on labeling the food as high or low in specific nutrients, products in the present study were studied for the same according to US-FDA recommendations. According to US-FDA, food products providing ≥400 Kcal/100g are categorized as “high-energy density foods” and ≥35% of their total energy from fat are categorized as “high-fat foods” (US-FDA, 2004;NAS-IOM, 2005).

Figure 4.2.3: Processed Packaged FoodsHigh in Energy (≥400 Kcal/100g) as per USFDA Criteria in Various Food Groups (in percentage)

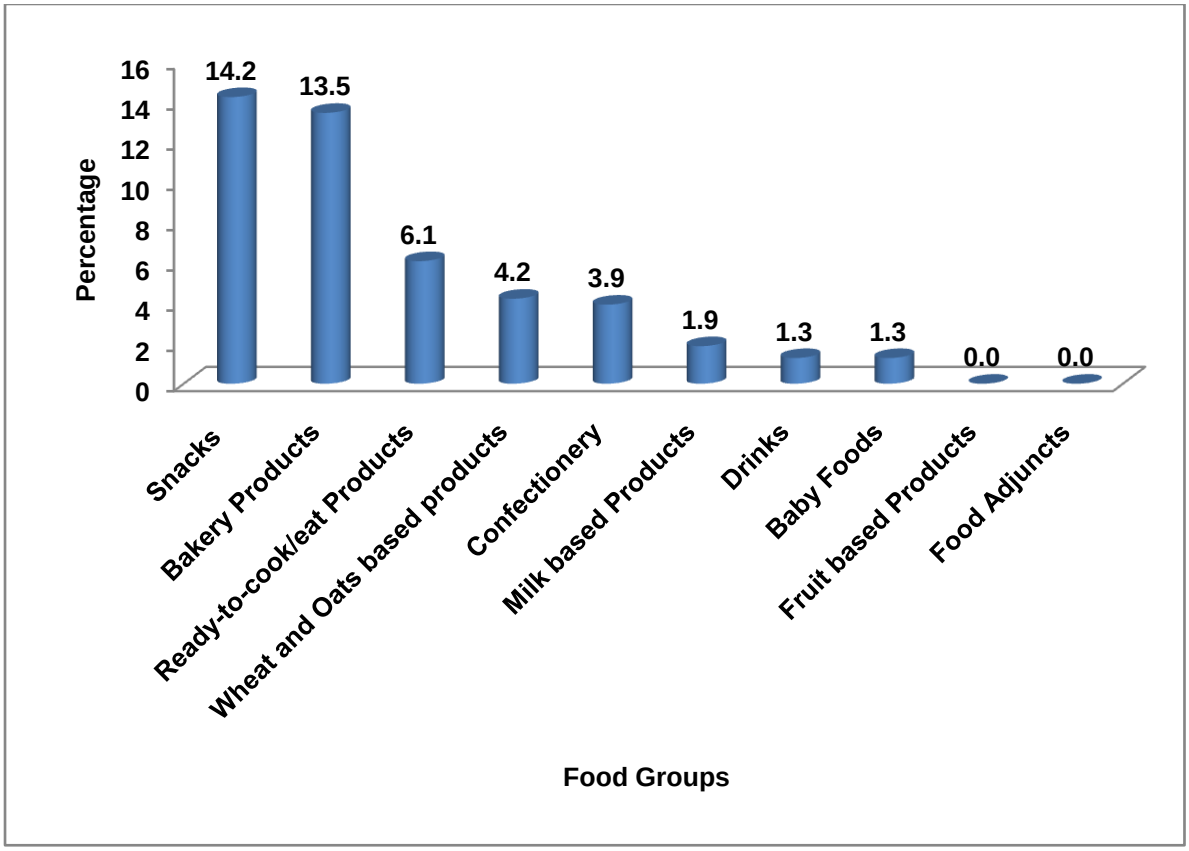


Figure 4.2.3 illustrates the food products that were high in energy content. Of the total products that reported energy value (n=1018), 46.4% (n=472) of the products were high in energy (≥400 Kcal/100g) as per US-FDA criteria. Similar study from China showed 42.1% of the products as high-energy density foods. Food group-wise, 14.2% of the snacks had ≥400 Kcal/100g energy, followed by bakery products (13.5%), ready-to-cook/eat products (6.1%), wheat and oats based products (4.2%), confectionery (3.9%), milk based products (1.9%), drinks (1.3%) , baby foods (1.3%), fruit based products (0%) and food adjuncts (0%). Majority of the foods that were high in energy content belonged to snack food items in the present study (14.2%) as well as the study from China (26%) (Tao et. al, 2010).

Figure 4.2.4: Processed Packaged Foods High in Fat (≥35% of the Total Energy from Fat) as per USFDA Criteria in Various Food Groups (in percentage)

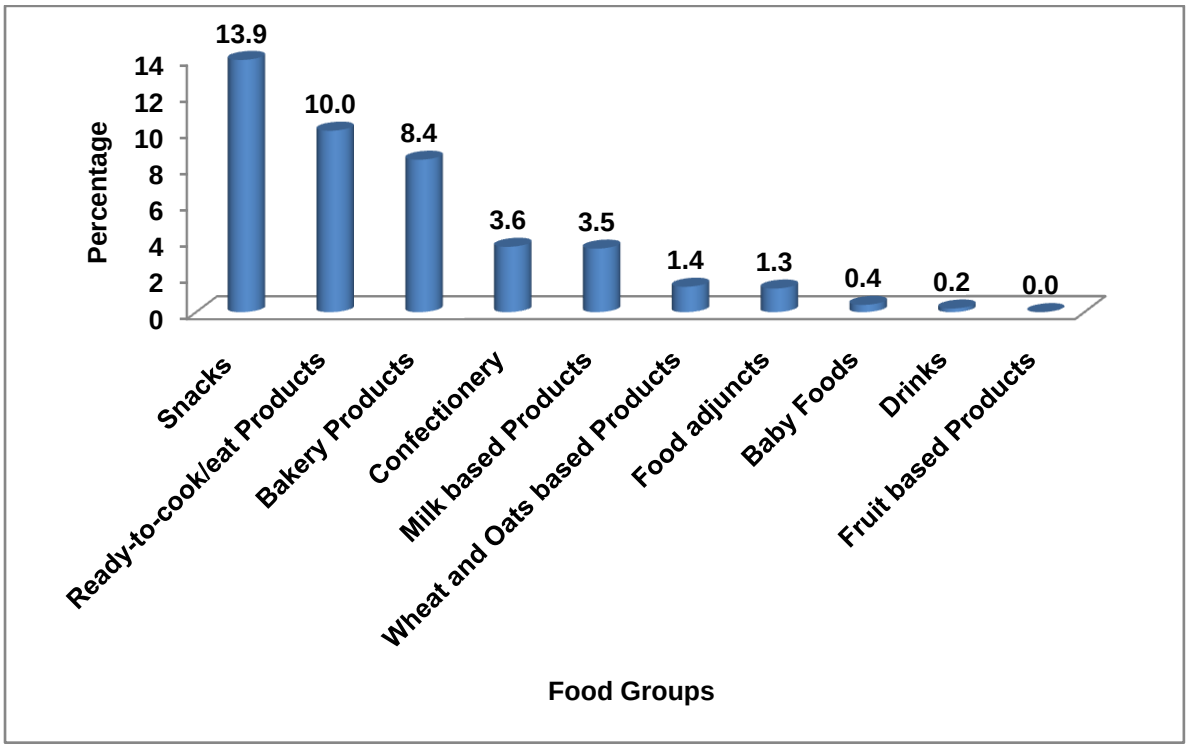


Figure 4.2.4 depicts food group-wise distribution of products as high in energy from fat. Of the total products that reported fat content (n=998), 42.8% (n=427) of the products were high in fat as per US-FDA criteria. It can be seen that 13.9% of the snacks had ≥35% of total energy from fat, followed by ready-to-cook/eat products (10%), bakery products (8.4%), confectionery (3.6%), milk based products (3.5%), wheat and oats based products (1.4%), food adjuncts (1.3%), baby foods (0.4%), drinks (0.2%) and none in fruit based products. Thus, snacks, bakery products, ready-to-cook/eat products and confectionery products emerged as the top four food groups with high energy as well as high fat foods. Findings from China also showed that snacks (21%) had the highest percentage of foods having ≥35% of total energy from fat as compared to the percentage of such foods across all food categories (Tao et. al, 2010).

The UK-FSA have set thresholds for the packaged foods in order to label them as low, medium or high for fat, SFA, salt and sugars. In the absence of such guidelines and thresholds by FSSA of India, the food products in the present study were assessed according to UK-FSA criteria as given in Table 4.2.4.

Table 4.2.4: Recommended Limits for Fat, Saturated Fat, Salt and Sugar by UK-FSA, 2007

Nutrients	Low (Per 100g)	Medium (Per 100g)	High (Per 100g)
Fat	≤3 g or less	>3.0 to ≤20 g	>20 g
Saturated Fat	≤1.5 g or less	>1.5 to ≤5 g	>5 g
Salt	≤0.3 g or less	>0.3 to ≤1.5 g	>1.5g
Sugars	≤5 g or less	>5.0 to ≤12.5 g	>12.5 g

Source: UK-FSA (2007)

Figure 4.2.5: Food Products Reporting High Content of Two or More Than Two Nutrients According to UK-FSA Criteria in Various Food Groups (in percentage)

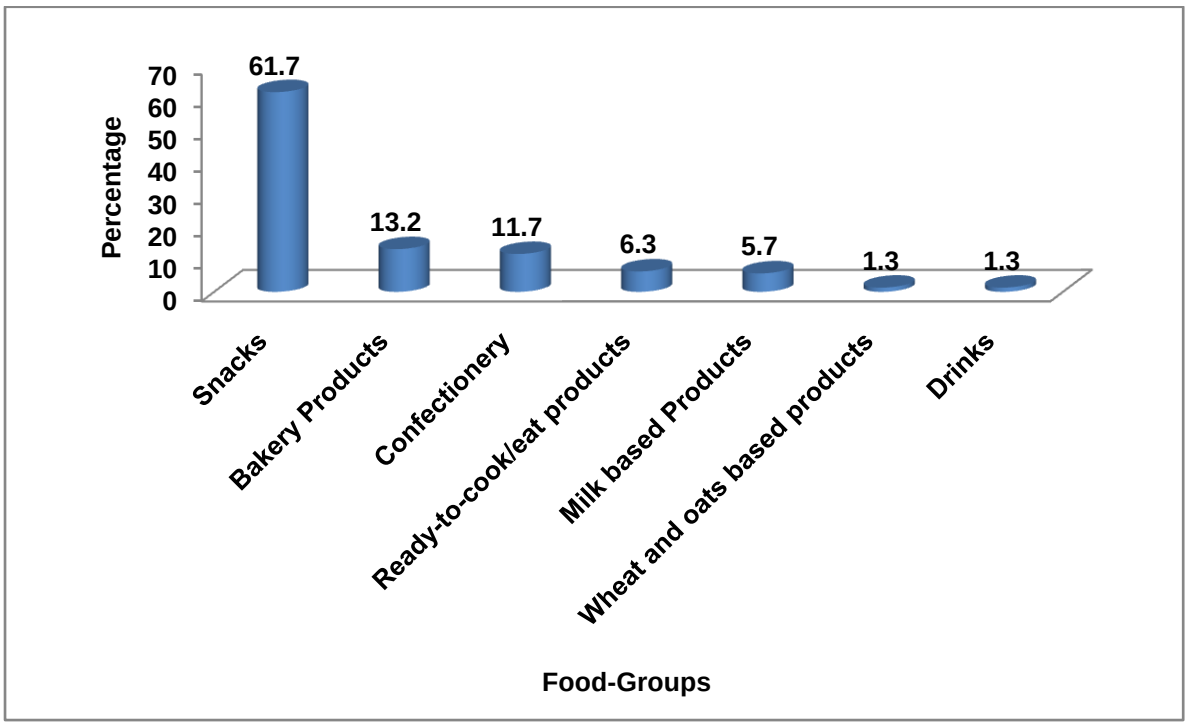


Figure 4.2.5 show the food group-wise data on food products having two or more than two nutrients "high" in the food group as per UK-FSA. Of the total products (n=159) that reported two or more than two nutrients as "high", 61.7% were snacks, followed by bakery products (13.2%), confectionery (11.7%), ready-to-cook/eat products (6.3%), milk based products (5.7%), wheat and oats based products (1.3%) and drinks (1.3%). Fruit based products, food adjuncts and baby foods did not have high content of two or more than two nutrients namely, fat, SFA, sugar and sodium.

Figure 4.2.6: Low, Medium or High content of Fat, SFA, Sugar and Salt as per UK-FSA Criteria in Total Products (in percentage)

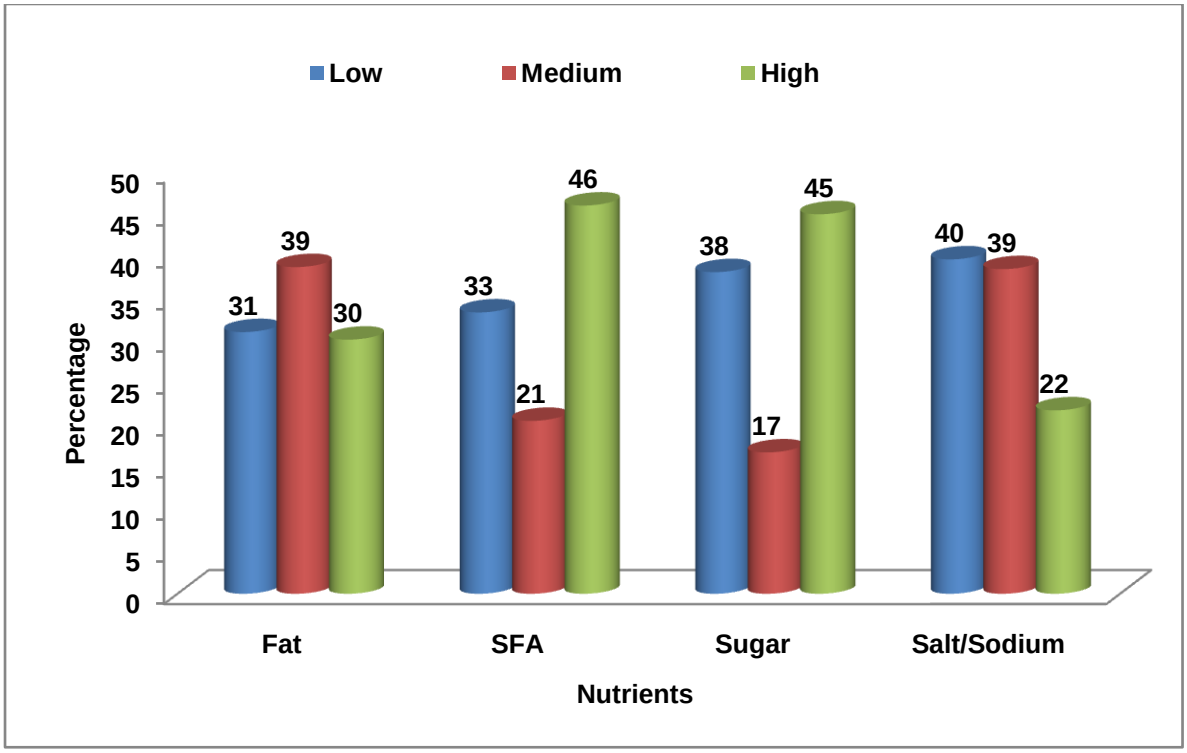


Figure 4.2.6 illustrates the reporting of nutrients namely, fat, SFA, sugar and sodium as low, medium or high in products as per UK-FSA criteria. Of the total products that reported fat (n=998), 30% (n=301) were high in fat content while almost same percentage i.e. 31% (n=310) were low in fat content. Medium fat content was found in 39% (n=387) of the products. SFA was reported by 536 products, of which 46% (n=247) were high in SFA content, 33% (n=179) of the products had low and 21% (n=110) had medium SFA content. Similarly, sugar was reported by 888 products, of which majority of the products i.e. 45% (n= 400) had high sugar content, 38% (n=339) had low and 17% (n=149) had medium sugar content. Sodium was reported by 519 products, of which 40% (n=206) of the products were low in sodium, 39% (n=200) had medium and 22% (n=113) had high sodium content. It was observed that of the 113 products that were high in sodium content, 26 products had MSG in ingredients list suggesting that the high sodium content could be due to the presence of MSG. Thus, from the data it can be inferred that majority of the food products were high in SFA and sugar while fat and sodium content in majority of the products was either low or medium. Subsequently, food group wise data on reporting low, medium and high content of fat, SFA, sugar and salt/sodium is presented in Table 4.2.5.

Table 4.2.5: Low, Medium or High content of Fat, SFA, Sugar and Salt as per UK-FSA Criteria in various Food Groups (in percentage)

Nutrients	High, Medium and Low Nutrients	Food Groups									
		Wheat and oats based products	Bakery Products	Confectionery	Fruit based products	Milk Based	Drinks	Ready-to cook/eat products	Food adjuncts	Snacks	Baby Foods
Fat	High	0.2	6.4	2.9	0.0	3.2	0.2	4.1	0.0	13.0	0.1
	Medium	7.1	7.3	1.6	0.1	0.3	1.2	16.7	1.6	1.6	1.2
	Low	3.8	0.0	0.0	4.3	0.0	10.2	6.8	5.6	0.2	0.1
SFA	High	3.0	9.3	4.5	0.0	1.9	0.4	5.8	1.3	19.8	0.2
	Medium	1.1	0.4	0.0	0.0	0.0	0.7	16.0	0.0	2.1	0.2
	Low	9.5	0.0	0.2	2.2	0.0	2.6	14.2	4.7	0.0	0.0
Sugar	High	1.9	12.5	5.1	4.6	0.6	7.3	8.4	4.1	0.3	0.2
	Medium	3.0	1.7	0.0	0.0	1.4	2.6	3.4	1.1	2.6	1.0
	Low	6.6	0.8	0.0	0.2	1.6	0.9	15.7	1.5	10.7	0.2
Sodium	High	0.8	0.0	0.0	0.2	0.0	0.0	17.1	2.9	0.8	0.0
	Medium	2.3	0.2	0.0	0.2	3.7	2.1	12.5	3.5	13.5	0.2
	Low	7.7	0.2	3.5	4.2	0.2	9.8	8.7	0.6	2.9	2.3

Table 4.2.5 presents data on reporting of fat, SFA, sugar and sodium as high, medium or low in various food groups. It can be seen from the table that high fat content was found in 13% of the snacks, followed by bakery products (6.4%), ready-to-cook/eat products (4.1%), milk based products (3.2%), confectionery (2.9%), wheat and oats based products (0.2%), drinks (0.2%), baby foods (0.1%) and none in food adjuncts. Similarly, high SFA content was found in 19.8% of snacks, followed by bakery products (9.3%), ready-to-cook/eat products (5.8%), confectionery (4.5%), wheat and oats based products (3%), milk based products (1.9), food adjuncts (1.3%), drinks (0.4%), baby foods (0.2%) and nil in fruit based products. Sugar was found to be high in 12.5% of the bakery products followed by 8.4% of ready-to-cook/eat products, 7.3% of drinks, 5.1% of confectionery, 4.6% of fruit based products, 4.1% of food adjuncts, 1.9% of wheat and oats based products, 0.6% of milk based products, 0.3% of snacks, 0.2% of baby foods. Sodium was found to be high in 17.1% of ready-to-cook/eat products, 2.9% of food adjuncts, 0.8% each in wheat and oats based products and snacks and 0.2% in fruit based products. The remaining products had medium or low sodium content.

Figure 4.2.7: Difference in Reported and Calculated Values of Energy, Fat and Calories from Fat (in percentage)

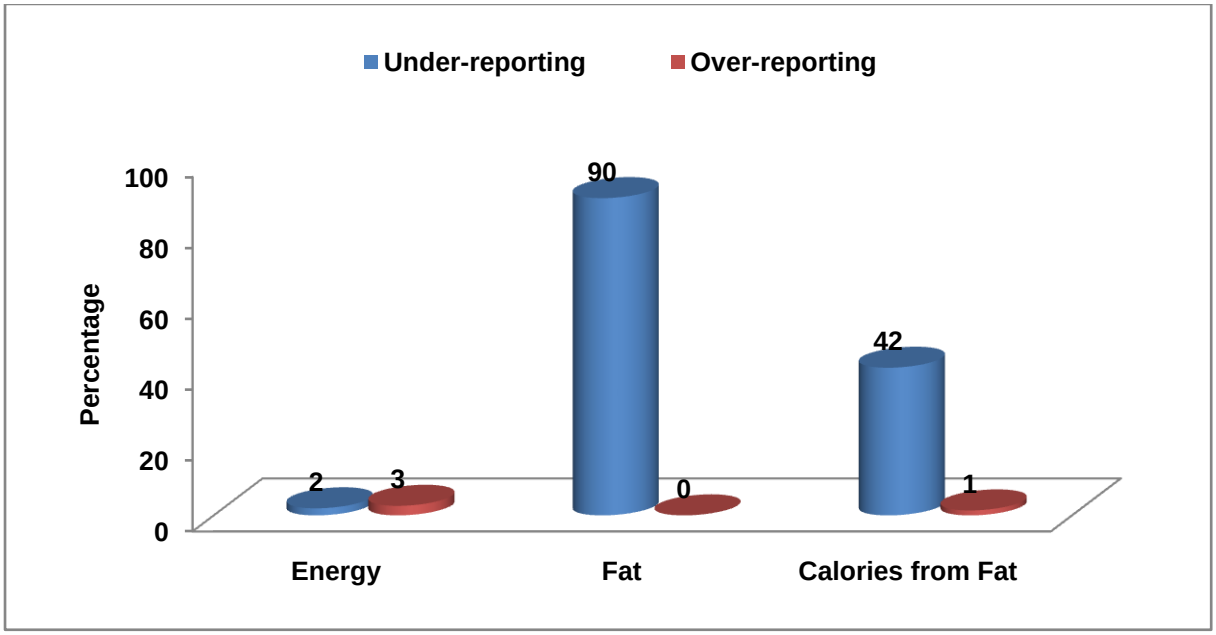


Figure 4.2.7 shows the difference in reported and calculated "energy", "fat" and "calories from fat" as "over-reporting" and "under-reporting". According to FSSAI, 10% variation in reported and calculated values is acceptable. Any variation over and below 10% is considered non-compliance and termed as over-reporting and under-reporting. Over-reporting is when the reported values are higher than calculated values and under-reporting is when the reported values are less than the calculated values. "Calculated energy" values were derived by adding up the energy from fat, protein and carbohydrates (Energy from fat= Fat x 9, Energy from protein= Protein x 4, Energy from carbohydrates= carbohydrates x 4). Of the total 1,020 products, 97.2% (n=991) reported all three energy contributing nutrients namely, fat, protein and carbohydrates on NFP. Out of 991 products that reported three energy contributing nutrients, 5% (under-reporting=2% and over-reporting=3%) were found to have a difference of >10% in reported and calculated energy values. The remaining products i.e. 95% were either having no difference or a difference of ≤10% in reported and calculated energy values.

According to FSSAI and Codex, it is voluntary to report the fractions of total fat (saturated fat, monounsaturated fat, polyunsaturated fat and trans fat) on NFP. However, when the complete fatty acid profile is given on NFP, the sum of the fractions of total fat should tally with the reported "Total Fat." Of the total food

products (n=1,020) only 365 products reported complete fat profile on NFP. It was found that of those that reported complete fatty acid profile (n=365), 90% of the products reported lower fat content as compared to calculated values. In other words, under-reporting of fat content was observed in 90% of the products. Ten percent of the products either had no difference or a difference of ≤10% in reported and calculated fat values.

Calories are essentially derived from three nutrients namely, fat, protein and carbohydrates. As compared to protein and carbohydrates, calories from fat are of major concern as 1 g of fat provides 9 Kcal vis-a-vis 4 Kcal/g from protein and carbohydrates. Therefore, in order to have at a glance information about calories coming from fat, many products report “Calories from fat” on NFP. Calculated calories from fat were derived by multiplying the reported fat content with the factor 9. When the difference between reported and calculated “calories from fat” was determined, it was found that of the total products (n=1,020) only 144 products reported calories from fat. Data presented in Figure 4.2.7 shows that 43% (under-reporting=42% and over-reporting=1%) of the 144 products had a difference of>10% in reported and calculated values for “calories from fat” while 57% of the products had either no difference or a difference of <10% in reported and calculated fat values.

It can be noted that under-reporting of “fat” and “calories from fat” was common thus projecting the products as healthy for consumption.

4.2.2 Ingredients List

Ingredients list provides information on the constituents of a food product. The list of ingredients should have an appropriate title, such as the term “Ingredients”. The ingredients used in the product should be listed in descending order of their composition/predominance (FSSA, 2011; USFDA, 2009).

Figure 4.2.8: Ingredients List Compliance with FSSA of India in Various Food Groups (in percentage)

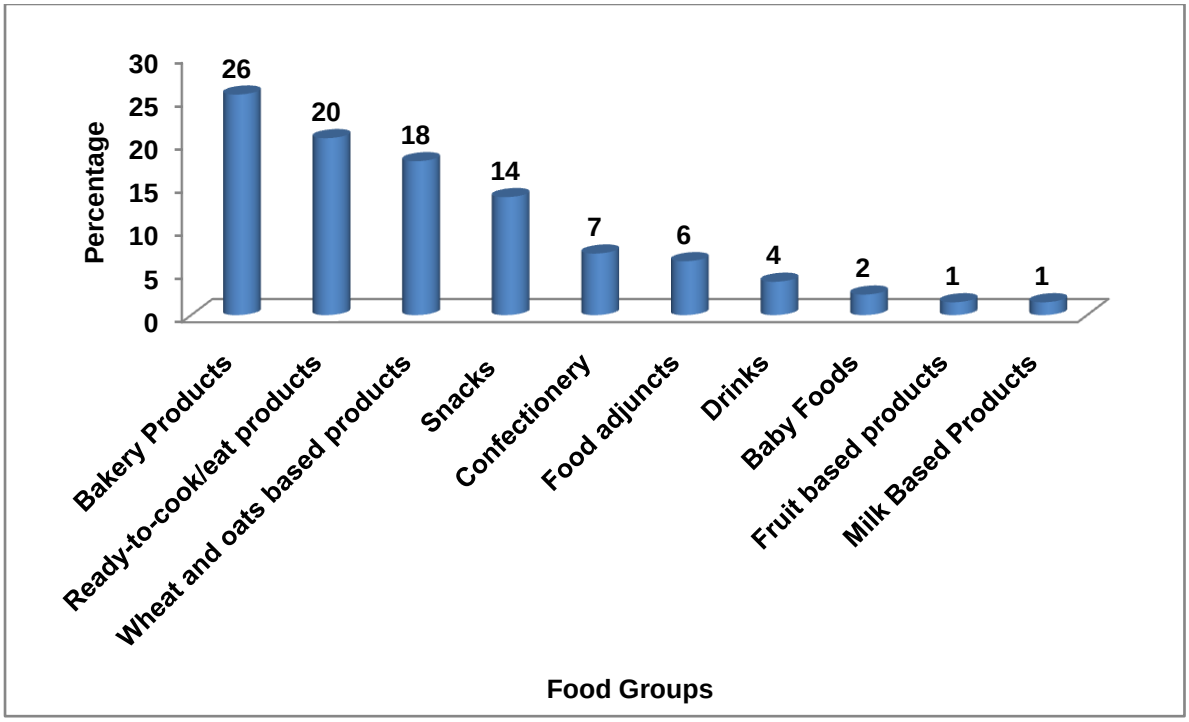


Figure 4.2.8 shows products complying with the FSSA guidelines for listing of ingredients. Of the total 1,020 products, only 337 products listed ingredients in descending order of percentage weights. Out of 10 food groups, only 4 namely, bakery products (26%), ready-to-cook/eat products (20%), wheat and oats based products (18%) and snacks (14%) had more than 10% of the products that complied with the FSSA guidelines. Ingredients listed in descending order of their weights help the consumers in selecting a healthy food product. It also alerts the consumers from consuming high amount of “ingredients of concern” namely, fat, sugar, salt and MSG and their corresponding nutrients. If the quantity or the source of “ingredients of concern” is more, then the NFP can be used to ascertain the nutrients derived from these ingredients. Thus, ingredients list can assist the consumers in making healthy food choices by avoiding foods with numerous/high in “ingredients of concern” and corresponding nutrients. USFDA suggest the consumers to look at the ingredients list to make sure that added sugars are not listed as one of the first few ingredients. (http://www.fda.gov/food/ingredientspackaginglabeling/labelingnutrition/ucm274593.htm)

Silverglade and Heller (2010) suggested few tips to understand ingredients list. According to them, if sugar or high fructose corn syrup (HFCS) is the first ingredient, the product is high in added sugars, if whole wheat flour is somewhere in the middle

of the ingredient list, the product may have only a small amount of whole grains. To make the ingredients list stand out on the label, the ingredients should be presented in a box by use of hairlines and should be all black or one color type, printed on a white or other highly contrasting background.

Table 4.2.6: Commonly Listed Alternative Sources/Names of the "Ingredients of Concern" in Ingredients list

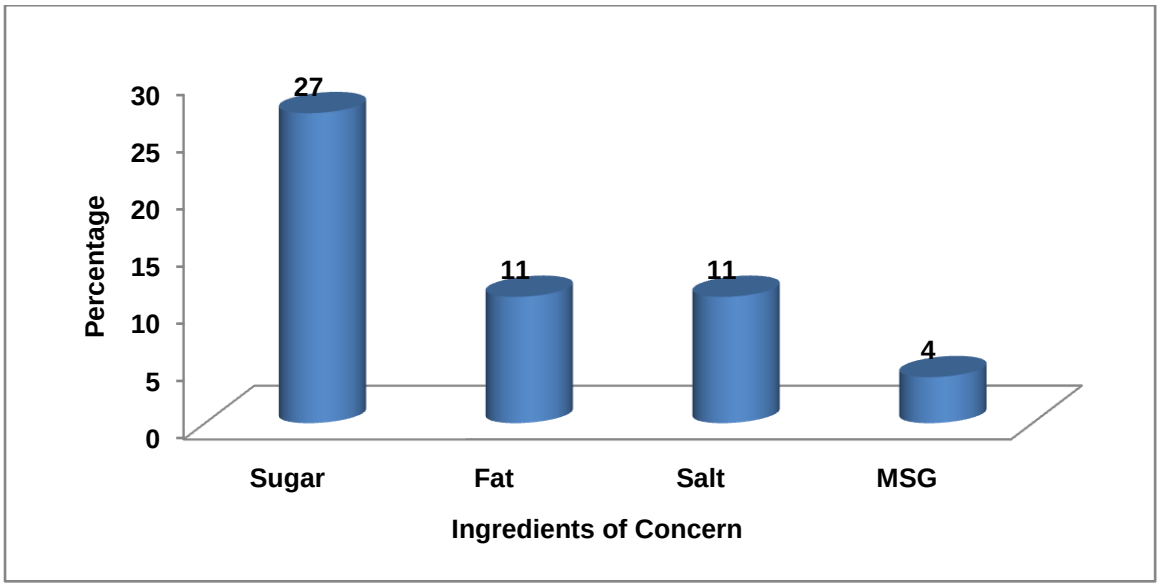
Fat	Sugar	Salt	MSG
• Hydrogenated Oils, • Partially Hydrogenated oils/Fats • Shortening • Margarine • Butter • Cocoa Butter • Edible Vegetable Hydrogenated oil • Refined Palm/Peanut/Palm olein oil • DHA Rich Algal Oil • High Oleic Sunflower oil • Soy oil • Cream • White Butter • Ghee • Mutton Fat • Fat Powder • Low Fat Cocoa Powder • Egg Yolk Powder	• Refined Sugar • Sucrose • Dextrose • Malt Extract • Maltodextrin • Cane Sugar • Honey • Jaggery • Invert Syrup/Sugar • Partially Inverted Sugar Syrup • Liquid Glucose • Caramelized Sugar • Sorbitol • Fructo-oligo Saccharide (FOS) • Aspartame • High Fructose Corn Syrup	• Edible Salt • Common Salt • Rock Salt • Iodized Salt • Baking Powder • Sodium Hydrogen Carbonate • Sodium Carbonate • Di-sodium 5-Inosinate • Di-sodium 5-Guanylate • Black Salt • Monosodium Glutamate • Sodium Caseinate • Sodium Molybdate • Sodium Selenite • Sodium Chromate • Sodium Citrate • Sodium Benzoate • Sodium Acetate • Calcium di-Sodium	• Hydrolyzed Vegetable protein • Hydrolyzed Corn Protein • Hydrolyzed Groundnut Protein • Hydrolyzed Plant Protein • Hydrolyzed Corn Solids • Soyabean Extract • Yeast Extract

Besides using the usual names of the ingredients, alternate names are often used in the ingredients list. It is important for the consumers to know the alternative names or their synonyms used by the manufacturers for "ingredients of concern." Table 4.2.6 details the various sources/names or synonyms used for fat, sugar, salt and MSG.

Manufacturers often list the "ingredients of concern" with different names in ingredients list to mask their visibility especially when a particular product contains high amount of one or more ingredients of concern. To deal with such a situation, Silverglade and Heller (2010) recommended that sugar sources in the product should be grouped together in the ingredient list so that consumers can

identify the ingredients that add to the total sugar content, get an idea about the relative amount of sugar in the product and not be misled by healthy-sounding names, such as “fruit juice concentrate.” Therefore, it can also be said that alternative names are the hidden sources of ingredients of concern. Such a practice by manufacturers creates ambiguity in selecting a healthy food product by the consumers.

Figure 4.2.9: Listing of More than One Source of “Ingredients of Concern" in Ingredients List in Total Products (in percentage)



In the present study ingredients list was studied to identify the various alternative sources/names used for fat, sugar, salt and MSG and the data are presented in Figure 4.2.9. It was assumed that any products containing more than one source of “ingredients of concern” with alternative names as given in Table 4.2.6 may be high in that particular ingredient and thereby high in the corresponding nutrient. It was found that among fat, sugar, salt and MSG, 27% of the total products had more than one source of sugar in ingredients list which was followed by 11%, 11% and 4% of the products with multiple sources of fat, salt and MSG respectively. In all, more than 50% of the products had one or more than one ingredients of concern in various forms/names, thus making food products unhealthy to consume. Various studies have shown that excess intake of sugar, fat, salt and MSG have adverse health outcomes. Sugar consumption and obesity have been positively correlated in various studies across the world (Bray et. al, 2004, Gross et. al, 2004). A parallel trend was observed between sugar consumption and rise in obesity in children, adolescents and adults (Drewnowski, 2007). Sugar and its alternative sources like fructose,

maltodextrin, etc. are commonly used in processed foods. Fructose consumption has increased dramatically in recent years. High-fructose corn syrup is used extensively in soft drinks, baked goods, condiments, prepared desserts, and other processed foods (Elliot et. al, 2002). In early 1970s, high-fructose corn syrup (HFCS) (a sweetener) was introduced in the United States as it has a longer shelf life and comparatively less costly than table sugar. The composition of HFCS is similar to that of sucrose and therefore is extensively used in soft drinks, fruit punches, pastries and processed foods. It was found that the combination of table sugar and HFCS has resulted in an additional 30% increase in overall sweetener intake over the past 40 years among US population (Johnson et. al, 2007).

Similarly, dietary fat, especially saturated fats, trans fat and monounsaturated fatty acids have been positively associated with the risk of developing hypertension, cardio vascular diseases, breast cancer, diabetes and other non-communicable diseases (Wang et. al., 2010; Nettleton et. al, 2009; Jordan et.al, 2013; Riserus et. al, 2009). Consumption of excess salt and MSG is not far behind in budding similar health conditions. Dietary salt has been identified as the major cause of raised blood pressure and that a reduction in salt intake lowers blood pressure, with a concomitant reduction in blood pressure-related diseases (Havas et. al, 2007; Asaria et. al, 2007; He and MacGregor, 2010; Sacks et. al, 2001; He and MacGregor, 2004; Hooper et. al, 2004; Cook et. al, 2007). According to recent WHO recommendation, an adult should not have more than 2g sodium per day (i.e. 5g salt per day) in order to reduce the risk of high blood pressure and coronary heart diseases (WHO, 2012). In America, more than 75% of the sodium consumed by the population comes from processed and restaurant foods (CDC, 2012). Thus, sodium or salt emerges as yet another ingredient of concern. Therefore, consumers should select the food product carefully in order to cut down their sodium intake.

Monosodium glutamate (MSG) which is found in canned, packaged and prepared foods is declared on the food labels with various names like “natural flavor”, “flavoring,” or “hydrolyzed vegetable protein (HVP).” HVP typically contains 10-30% MSG. Ingredients list on food labels help in identifying MSG and HVP (Scopp, 1991). A study in China showed a positive correlation between MSG intake and higher BMI and obesity. Prevalence of overweight was found to be significantly higher in MSG users than non-users (Liancheng et. al., 2008; Insawang et. al, 2012; He et. al, 2011). Another study found an association between MSG consumption and the risk of developing metabolic syndrome (Insawang et. al, 2012). Therefore, these

ingredients are also termed as “ingredients of concern” due to their associated health risks and needs to be cut down in daily diet.

Table 4.2.7: Listing of More Than One Source of “Ingredients of Concern" in Ingredients List in Various Food Groups (in percentage)

Food Groups	Sugar	Fat	Salt	MSG
Wheat and oats based products	4.4	1.0	1.0	1.0
Bakery products	9.0	3.7	0.9	0.0
Confectionery	2.1	1.6	0.5	0.0
Fruit based products	0.3	0.0	0.0	0.0
Milk based products	0.6	0.4	0.1	0.0
Drinks	4.2	0.2	1.0	0.0
Ready-to-cook/eat products	2.6	4.0	4.4	2.1
Food adjuncts	0.8	0.0	0.3	0.2
Snacks	2.2	0.1	2.9	0.6
Baby foods	0.6	0.3	0.0	0.0

Table 4.2.7 presents food group-wise data on listing of multiple sources of “ingredients of concern" in ingredients list. Of the total products (n=1,020) more than one source of sugar was found in 9% of the “bakery products”, followed by wheat and oats based products (4.4%), drinks (4.2%), ready to cook/eat products (2.6%), snacks (2.2%), confectionery (2.1%), food adjuncts (0.8%), milk based products (0.6), baby foods (0.6%) and fruit based products (0.3%). Ready-to-cook/eat products and bakery products had highest number of food items (4% and 3.7%, respectively) with multiple sources of fat followed by confectionery (1.6%), wheat and oats based products (1.0%), milk based products (0.4%), baby foods (0.3%), drinks (0.2%) and snacks (0.1%). Ready-to-cook/eat products had the highest percentage (4.4%) of products listing multiple sources of salt with alternative names which was followed by snacks (2.9%), wheat and oats based products (1%), bakery products (0.9%), confectionery (0.5%), food adjuncts (0.3%), milk based products (0.1%).MSG sources were highest in ready-to-cook/eat products (2.1%) followed by wheat and oats based products (1%), snacks (0.6%) and food adjuncts (0.2%). When MSG (a

source of sodium) and salt were considered together, ready to cook/eat products were found to have highest percentage (4.5%) of Salt+MSG.

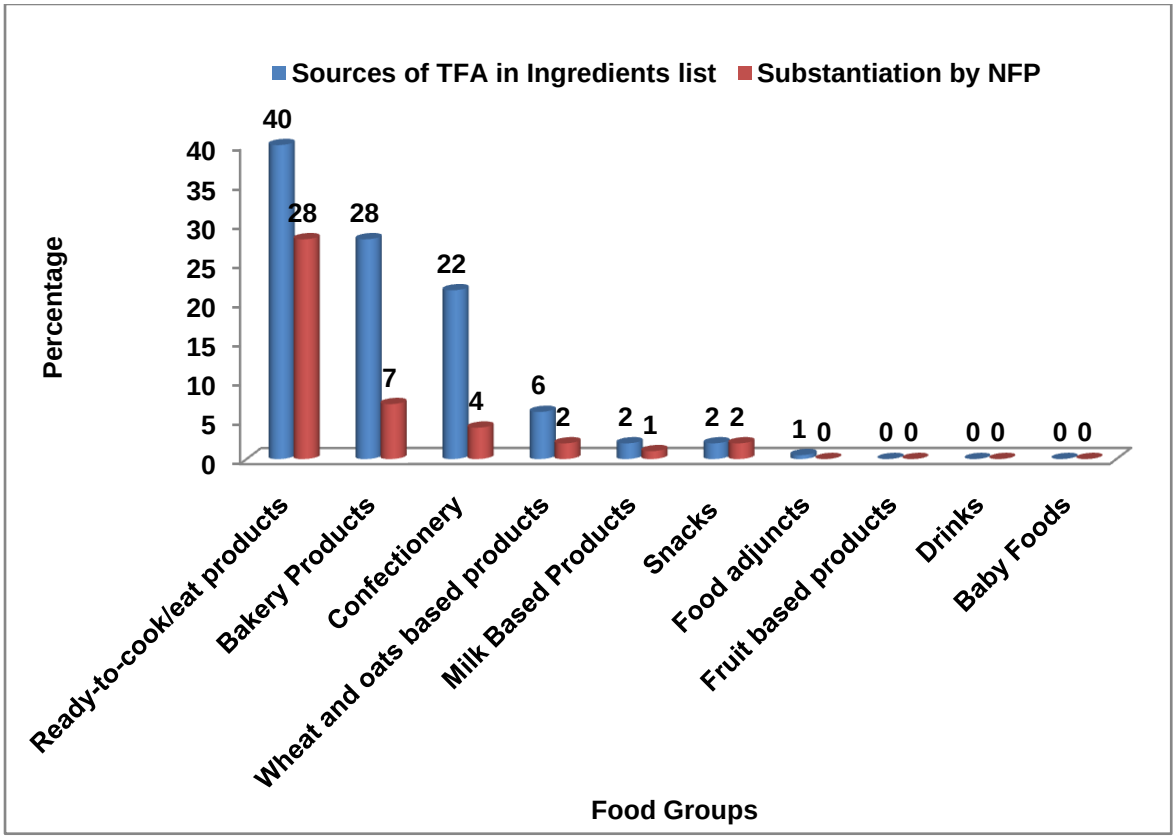
In the recently proposed changes on food labeling by Health Canada and USFDA, it is recommended to list all the sources of sugar together in the ingredients list in parentheses preceded by the word “Sugar.” However, any such recommendation has not been made for fat, salt and MSG (http://www.healthycanadians.gc.caand http://www.fda.gov).

These results show that the practice of labeling “ingredients of concern” with different names is common and using more than one source of such ingredients may lead to high concentration of these unhealthy ingredients. As per the food laws, mandatory listing of ingredients in descending order of their weight percentage infers that first few ingredients are the major contributors of the food. Therefore, when several sources of “ingredients of concern” are listed separately in ingredients list, the product though high in the specific nutrient of concern yet the ingredient does not appear in first few places in ingredients list. However, the product may have high concentration of “ingredients of concern” but in distributed manner with alternatives sources/names.

Sources of Trans Fatty Acids (TFAs) in Food Products

In the present study, of the total products containing fat sources (61%, n=627), 19.6% (n=200) had trans fat sources in ingredients list with various alternative names like cocoa butter, bakery shortening, margarine, hydrogenated vegetable edible oil, ghee, white butter, butter, chicken fat, mutton fat, hydrogenated vegetable fat, vanaspati, milk fat etc. Of the 200 products that had trans fat sources in ingredients list, only 42% (n=84) substantiated the presence of trans fat by NFP suggesting poor substantiation of trans fat content in food products. Figure 4.2.10 illustrates the sources of TFA in various food groups and their substantiation by NFP.

Figure 4.2.10: Sources of Trans Fatty Acids (TFAs) in Ingredients List and their Substantiation by NFP in Various Food Groups (in percentage)



From the Figure 4.2.10 it can be observed that of the total products that listed TFA source (n=200) in ingredients list, 40% were from ready-to-cook/eat products, followed by bakery products (28%), confectionery (21.5%), wheat and oats based products (6%), milk based products (2%), snacks (2%) and food adjuncts (0.5%). Food groups namely, fruit based products, drinks and baby foods are not the potential sources of fat and trans fat and therefore had no TFA sources in ingredients list. Presence of trans fat sources in ingredients list was poorly substantiated by NFP. Listing of trans fat sources in ingredients list versus their reported values on NFP was 28% versus 7% in bakery products, 22% versus 4% in confectionery, 40% versus 28% in ready-to-cook/eat products, 6% versus 2% in wheat and oats based products, 2% versus 1% in milk based products and 1% versus 0% in food adjuncts. Snacks was the only food group wherein presence of trans fat sources in ingredients list was equally substantiated by NFP. Similar trends were obtained in another study done in India where major contributors of TFAs were commercially fried, processed, bakery, ready-to-eat products, biscuits, sweets and street foods (contained up to 40% TFA)(Ghafoorunissa, 2008). In western diets for e.g. Canadian diet, foods like cookies, crackers, frozen potato products, tub margarine, vegetable shortening,

brownies, cakes and croissants are the major TFA contributors (Ratnayake et. al, 2009). Processed foods prepared with PHVO as one of the ingredients have been reported to contain upto 45% TFA of the total fat. In bakery shortenings TFA forms 30% of the total fats, whereas animal fats from ruminants such as butter contain up to 4% of TFA (Hunter, 2005). Various human and animal studies show a positive association between trans fatty acid intake and risk of metabolic syndrome, fasting serum insulin, high sensitivity C-reactive protein, waist circumference and body mass index (BMI) (Lee et. al, 2008a). TFAs are associated with higher risk of cardio vascular diseases (CVD) even at low level of consumption (Roos et. al, 2001). Higher total trans-fatty acids in red blood cell membranes were associated with a modest increase in the risk of primary cardiac arrest after adjustment for medical and lifestyle risk factors (Lemaitre, 2002). According to the scientific panel discussion of European Food Safety Authority (EFSA), the effects of TFA on biomarkers for CVD risk and related outcomes differ according to the origin of TFA i.e., from ruminant animals or industrially produced trans fats. Therefore, as per the panel's suggestion, Dietary Reference Values (DRVs) for TFA should be restricted to industrially produced TFA as the consumption of TFA from ruminant animals is lower than that derived from "industrial" source (EFSA, 2010).

In India, FSSA has mandated to state "hydrogenated vegetable fats or bakery shortening used-contains trans fats" on the food labels in which hydrogenated vegetable fats or bakery shortening is used. Also, a food label can use a health claim of "trans fat free" when the trans fat is less than 0.2 g per serving of food (FSSA, 2011). Though these recommendations are in place yet it is not mandatory to label trans fat content on NFP. Therefore, more clear and specific guidelines need to be developed by FSSA. There is also ambiguity in listing of sources of fat and trans fat in ingredients list and presence of multiple sources of fat complicates the situation even more for the consumers to understand the food labels for trans fat content and sources.

Evidence suggests that several countries initiated remedial steps to ban trans fats a decade ago. Denmark became the first country in banning industrial trans fat in 2003 from the food supply namely, restaurants, coffee shops, small stalls, hospitals, cafeterias and imported food products. Denmark was followed by Austria and Switzerland in 2009 to ban trans fat, however, Canada (in 2003) and US (in 2006) made it mandatory to report trans fat on the food labels. It was also introduced that a

product can be labeled as “trans fat free” if it contain upto 0.5g trans fat per portion. Similarly, New York, Brazil, Argentina, Chile and South Africa followed suit of reducing or eliminating trans fat from the food (Coombes, 2011). However, no such initiatives have been taken in India. Healthy processing techniques and product re-formulation is the need of the hour in India.

4.2.3. Allergen Information

Allergen information is useful for consumers with allergies from a particular food or ingredient. According to the International food labeling guidelines i.e. Codex Alimentarius, foods and ingredients that are known to cause hypersensitivity shall always be declared on the food labels. Ingredients identified as common allergens by Codex are,

a. Cereals containing gluten, i.e., wheat, rye, barley, oats, spelt or their hybridized strains and their products
b. Crustaceans and products
c. Egg and egg products
d. Fish and fish products
e. Peanuts, soybeans and their products
f. Milk and milk products (including lactose)
g. Tree nuts and nut products
h. Sulphite in concentrations of 10 mg/kg or more (WHO/FAO, 2010).

Though, there are more than 170 foods identified as allergy causing, these eight are “priority food allergens” as they are responsible for 90% of the total food allergies. Other less common allergenic foods are legumes, fruits and fruit juices (e.g., kiwifruit, apple, grape) and vegetables (e.g., celeriac, carrot, onion) (Boyce et. al, 2010).

According to Indian Food Laws i.e. FSSA, ingredients which are known to cause hypersensitivity shall be listed even if the ingoing quantity is less than 5%. The commonly identified allergens by FSSA are similar to Codex. However, FSSA have identified an additional allergenic ingredient namely, blackgram as the cause of hypersensitivity/allergy and thus included in the list of allergens (FSSA, 2011).

Table 4.2.8: Allergenic Substances declared on Food Labels by Manufacturers in Various Food Groups(Frequency)

S.No.	Allergenic Substances on Food Labels	Wheat and oats based products (N=112)	Bakery Products (N=137)	Confectionery (N=45)	Fruit based Products (N=44)	Milk based Products (N=35)	Drinks (N=119)	Ready-to-cook/eat Products (N=278)	Food Adjuncts (N=87)	Snacks (N=149)	Baby Foods (N=14)
1.	**Cereals containing gluten**	21	2	14	0	0	1	38	9	12	0
2.	**Crustaceans and Products**	0	0	0	0	0	0	0	0	0	0
3.	**Eggs and Products**	1	0	0	0	0	0	0	0	0	0
4.	**Fish and Products**	0	0	0	0	0	0	0	0	0	0
5.	**Peanuts, soybeans and Products**	30	2	3	0	0	1	21	9	13	0
6.	**Milk and Products**	23	2	18	0	0	2	50	8	3	1
7.	**Treenuts and Nuts**	15	1	27	0	0	1	74	10	20	0
8.	**Sulphite**	1	0	0	0	0	0	1	0	0	0
9.	**Sesame**	6	0	5	0	0	0	4	17	11	0
10.	**Mustard Seeds**	8	0	0	0	0	0	5	10	0	0
11.	**Corn**	3	0	0	0	0	0	0	0	0	0
12.	**Celery**	0	0	0	0	0	0	5	0	0	0
13.	**Gluten Free**	0	0	0	0	0	0	3	2	7	0
14.	**Contain No Milk or Milk Derivatives**	0	0	0	0	1	0	0	0	0	0

***Note**: S.No. 1 to 8: Eight major allergens declared by manufacturers as per Codex and FSSA*

S.No. 9 to 14: Other allergens declared by manufacturers

Table 4.2.8 details the declaration of allergens on food labels by the manufacturers. It was observed that the most frequent advisory/precautionary declaration was on “treenuts and nuts” (n=148 products). It was found to be highest in ready-to-cook/eat products (n=74), followed by confectionery (n=27), snacks (n=20), wheat and oats based products (n=15), food adjuncts (n=10), bakery products and drinks (n=1 each). The second highest advisory/precautionary declaration was on “milk and milk products” (n=107 products). It was highest in ready-to-cook/eat products (n=50),

wheat and oats based products (n=23), confectionery (n=18), food adjuncts (n=8), snacks (n=3), bakery products and drinks (n=2 each) and baby foods (n=1). Ninety seven products carried advisory/precautionary declaration on “cereals containing gluten”, of which 38 were from ready-to-cook/eat products, 21 from wheat and oats based products, 14 from confectionery, 12 from snacks, 9 from food adjuncts, 2 from bakery products and 1 from drinks. Advisory/precautionary declaration on “Peanuts, soybeans and their products” (n=79 products) were found to be highest in wheat and oats based products (n=30), followed by ready-to-cook/eat products (n=21), snacks (n=13), food adjuncts (n=9), confectionery (n=3), bakery products (n=2) and drinks (n=1). “Eggs and their products” and “sulphite” related advisory/precautionary declarations were found only 1 and 2 products respectively. None of the products had crustaceans and fish and their products related advisory/ precautionary statements. It was also observed that beside eight major identified food allergens by FSSA, manufacturers declared allergen information related to sesame (n=43 products), mustard seeds (n=23 products), gluten free (n=12 products), celery (n=5 products), corn (n=3 products) and contains no milk or milk derivatives (n=1 product) on food labels. In addition to 8 major allergens, a study carried out in Bangalore, India identified several other allergenic foods or ingredients namely, crabs, coffee, chicken, apple, potato, grape, onion, spinach , mustard , ginger , cucumber , rice, prawn , coconut (Rao et. al, 2010).

Though, Codex and FSSA have identified most common hypersensitivity causing ingredients and recommended to declare on the food labels, yet they have not mandated the labeling of the same as “advisory or precautionary declarations” on the food labels. Further, positioning, specific format and language to declare allergens has not been specified by the regulating agencies. The voluntary labeling and various type of allergen information as advisory/precautionary declarations commonly found on food products surveyed in the study is presented in Table 4.2.9.

Table 4.2.9: Presentation of Allergen Declaration on Food Labels

• Contain Nuts, Milk, Dairy, Gluten, almond, Treenut, Wheat, Soy, Sesame, Corn, Peanuts, Wheat, Mustard Seeds, Egg, Lecithin, Cashewnut, Lactose, Pistachio, Celery, Hazelnut.
• May contain traces of soya powder, milk powder, mustard seeds.
• Milk is not an ingredient in this product but due to process conditions traces may be present.
• This product is made in same facility where milk, treenuts, soy, peanuts, wheat are also prepared.
• This product was processed on machinery and in a plant that also processed wheat, peanuts, treenuts, sesame seeds, soy and milk (dairy and dairy products).
• Manufactured on equipments that processes products containing milk, peanuts and treenuts.
• This packet contains Rava/Suji which may be allergenic or hypertensive ingredient.
• Packed in a plant that processes dairy, wheat flour, nuts and sesame seeds.
• Due to production methods this product may contain traces of nuts.
• Gluten free
• Gluten free, May Contain Nuts

Of the total 1,020 products, 218 (21.4%) products carried allergen advisory/precautionary declaration on food labels. The remaining 802 products did not carry any allergen information as advisory/precautionary statements. Of these 802 products that did not carry advisory/precautionary declaration, 492 had one or more allergenic ingredients in ingredients list. Thus, the allergenic substance was present either in ingredients list or in any format as advisory/precautionary declarations as given in Table 4.2.9. In order to have more specific allergen declaration, Food Allergy Labeling and Consumer Protection Act (FALCPA) proposed changes regarding the declaration of the same.

According to FALCPA, an allergen can be stated on the food labels in one of the following two ways:

1. By placing the common or usual name of the allergen in the list of ingredients followed in parentheses by the name of the food source from which the

allergen is derived. For e.g., enriched flour (wheat flour), whey (milk), lecithin (soy).

2. By placing the word “Contains” followed by the name of the food source from which the major food allergen is derived immediately after or next to the list of ingredients, in text size no smaller than that used for the list of ingredients. For e.g., “Contains wheat, milk, egg and soy” (http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/labelingnutrition/ucm064880.htm#label)

Figure 4.2.11: Allergen Declaration on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

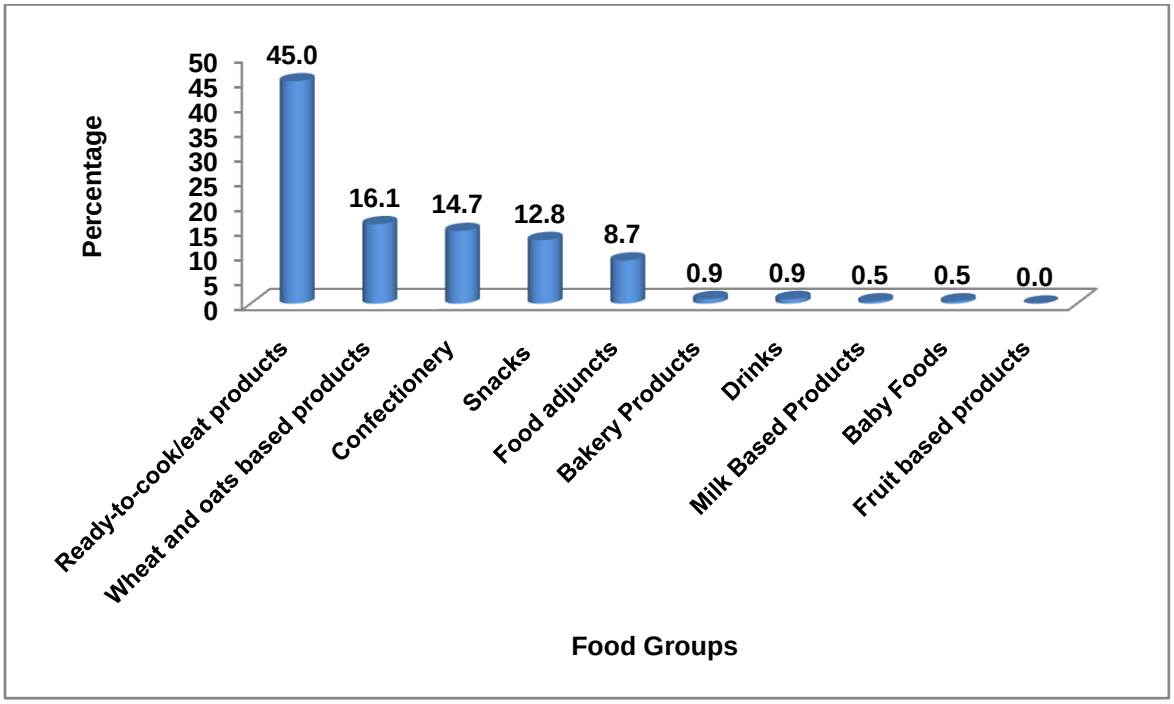


Figure 4.2.11 reports the allergen declaration on food products from various food groups. It was observed that of the total products (n=218) that displayed allergen information 45% of the ready to cook/eat products contained allergen information followed by wheat and oats based products (16.1%), confectionery (14.7%), snacks (12.8%), food adjuncts (8.7%), bakery products (0.9%), drinks (0.9%), milk based products (0.5%) and baby foods (0.5%). Ready to cook/eat products carried allergen information related to gluten (free or contain), nuts, dairy, sesame seeds, mustard, almond, pistachio, milk, sulphite, wheat, soya, treenuts, peanuts, celery while snacks for peanut, cashew, treenuts, gluten, sesame seeds and wheat and oats based products wheat, soyabean, mustad seeds, milk, confectionery for wheat, soy, lecithin. Within “ready to cook/eat products” group “ready to use spice mixes” and “soups”

had the highest percentage of the products (17% and 15% respectively) displaying allergen precautionary/advisory statements. Similar, study on allergy related advisory statements conducted in New York (n=20,241 food products) revealed that 17% of the products contained allergen information. Data also revealed that chocolate candy (54%), cookies (53%), baking mixes (40%) and pancake mixes (32%) were among the top 24 food categories with the highest frequency of advisory labeling. The lowest use of advisory labels were found in food categories namely, frozen bread/dough (8.6%), soups (8.5%), frozen entrees (6.3%), gravy/sauce mix (6.2%), syrup (5.7%), salad dressing (4.9%), shortening/oil (4.7%), frozen seafood (4.6%), pasta sauce (4.1%), canned fish (2.2%), baby food (1.3%) and spices (1.1%) (Pieretti et. al, 2009). These findings suggest that complete information on allergens is not being displayed on the food packages, which is a matter of concern.

Table 4.2.10: Type of Allergen Declaration on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

Food Groups	Type A	Type B	Type C	Type D
	"Contain" Allergenic Substance	**"May Contain" Allergenic Substance**	**"Free" from Allergenic Substance**	**Combination of "Contain" and/or "May Contain" and/or "Free"**
Total Products (%)	**39.0**	**31.7**	**2.8**	**26.6**
Wheat and oats based products	1.8	6.0	0.0	8.3
Bakery Products	0.5	0.0	0.0	0.5
Confectionery	6.0	4.1	0.0	4.6
Fruit based products	0.0	0.0	0.0	0.0
Milk based products	0.0	0.0	0.5	0.0
Drinks	0.9	0.0	0.0	0.0
Ready-to-cook/eat products	23.4	14.2	0.9	6.4
Food adjuncts	3.7	2.8	0.5	1.8
Snacks	2.8	4.1	0.9	5.0
Baby foods	0.0	0.5	0.0	0.0

The observed allergen information in the present study broadly fall in the following formats,

a. **Type A**: "Contain" allergen name- This format of allergen declaration suggests that the allergenic substance is present in the food product as an ingredient. For e.g. "Contain Nuts and Milk."
b. **Type B**: "May Contain" allergen name or "Manufactured on equipments/in same facility where "allergen name" are processed-This format of allergen

declaration suggests that the allergen is not the constituting ingredient of the product but present in traces due to cross contamination from shared equipment and/or processing environment. For e.g. “May Contain Soy” or “Manufactured on equipments that process products containing milk, peanuts and treenuts.”

c. **Type C**: Allergen Name “Free”-This format of allergen declaration suggests that the product is free from the given allergen. For e.g. “Gluten Free.”
d. **Type D:** Combination of any two (Type A/Type B/Type C) or all three (Type A and Type B and Type C)- This format of allergen declaration suggests that the product is free from one allergenic substance but contained another allergenic substance as an ingredient or in traces due to cross contamination. For e.g. “Contain Nuts, Gluten Free” or “May Contain Nuts, Manufactured in facility where wheat and soy are also prepared.”

It is evident from the Table 4.2.10, that of the 218 products having allergen declaration, “Type A” allergen information was present in 39% of the products. Food group-wise, Type A allergen declaration was displayed more often by ready-to-cook/eat products (23.4%), confectionery (6%), food adjuncts (3.7%), snacks (2.8%), wheat and oats based products (1.8%), drinks (0.9%) and bakery products (0.5%). “Type B” allergen declaration was most commonly found in ready-to-cook/eat products (14.2%), wheat and oats based products 96%), confectionery (4.1%), snacks (4.1%), food adjuncts (2.8%) and baby foods (0.5%). “Type C” allergen declaration was found in few products in food groups namely, ready-to-cook/eat products (0.9%), snacks (0.9%), milk based products (0.5%) and food adjuncts (0.5%). “Type D” allergen declaration was found in wheat and oats based products (8.3%), ready-to-cook/eat products (6.4%), snacks (5%), confectionery (4.6%), food adjuncts (1.8%) and bakery products (0.5%). It is worth noting that fruit based products had no allergen information as these products rarely have any allergenic substance. Baby foods should be allergen free, however a small percentage of products (0.5%) in this group had allergy information suggesting the presence of allergenic substance.

Similar observations were found in a study carried out in New York on various kind of advisory statements used for allergy information. It was grouped in 3 general categories namely, ‘‘may contain” (38%), ‘‘shared equipment” (33%) and ‘‘within plant” (29%) (Pieretti et. al, 2009).

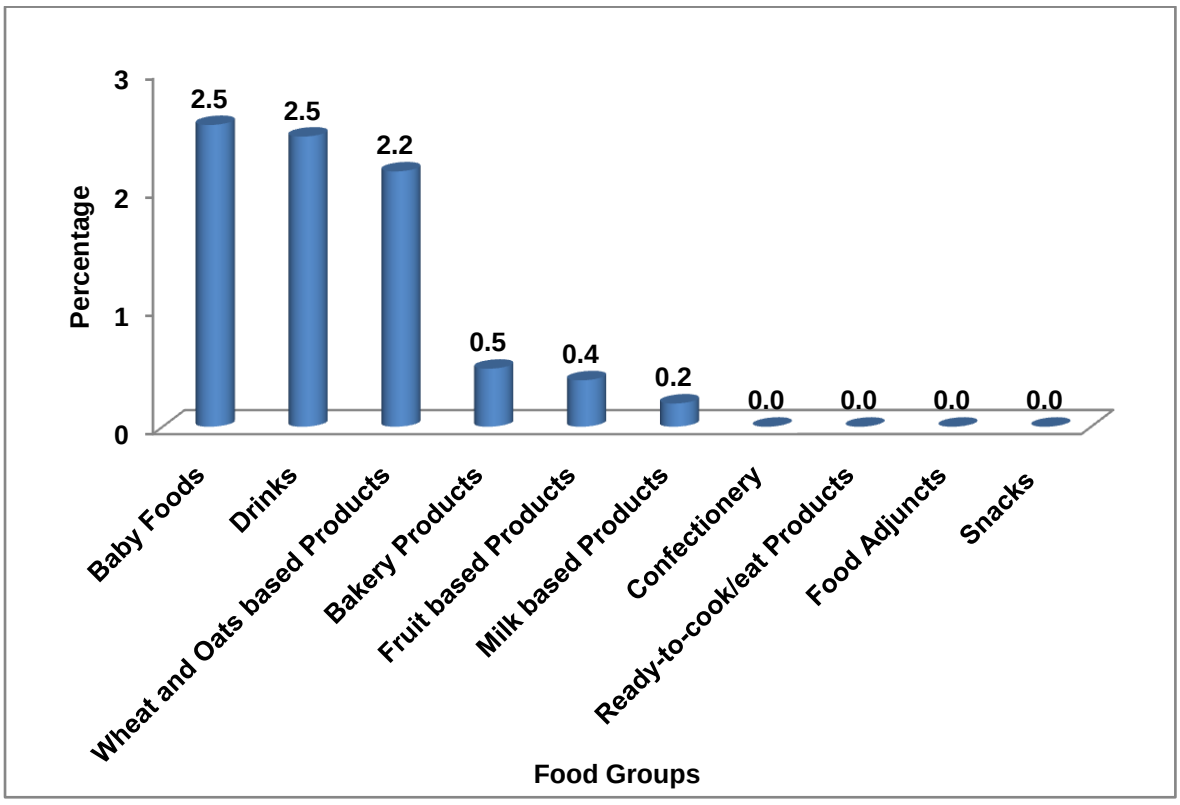
Therefore, food labels play an important role in managing allergic reactions in an individual. A study revealed that allergic reactions in some cases occurred due to the

lack of understanding of food label terminologies (16%) and to certain non-specific terms namely, spice, flavor etc (22%) (Simons et. al, 2005). An Australian study carried out to determine the accuracy in reading food labels by the parents of food allergic children revealed that most of the parents were unable to identify common allergenic food ingredients on the food labels. The study suggested the need for improved food labeling with plain-English terminology and allergen warnings and to educate patients and caregivers about food labeling (Joshi et. al, 2002). Thus, appropriate reporting of food allergens on food labels can play an important role in managing allergic reactions in an individual.

4.2.4. HEALTH CLAIMS

Health claims usually displayed on FOP are related to diet-linked risk factors and wellness. Diet-related health claims are useful for consumers in making informed food choices. Health claims should be consistent and not deceptive. They should be based on recognized health and scientific criteria and should describe the characteristics of a diet associated with reduced risk of developing chronic disease identified in the health claim (Emrich et al, 2012a).

Figure 4.2.12: **Health Claims Declared on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)**



According to FSSA (2011), "Health claims" means "any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health and include nutrition claims which describe the physiological role of the nutrient in growth, development and normal functions of the body, other functional claims concerning specific beneficial effect of the consumption of food or its constituents, in the context of the total diet, on normal functions or biological activities of the body and such claims relate to a positive contribution to health or to the improvement of function or to modifying or preserving health or disease, risk reduction claim relating to the consumption of a food or food constituents, in the context of the total diet, to the reduced risk of developing a disease or health related condition." Health claims on the front of the package have a positive role in selecting a healthy product (Lazaridis and Nayga, 2006). In the present study, only 8.3% of the total products reported health claims however, a study carried out in Hyderabad on 1,219 pre-packaged foods showed that 78% of the surveyed food products carried health claims (Manthena et. al, 2012). Figure 4.2.12 show that baby foods and drinks had the highest percentage (2.5% each) of health claims, followed by wheat and oats based products (2.2%), bakery products (0.5%), fruit based products (0.4%) and milk based products (0.2%). A survey in Sydney, Australia on 1,028 food products from three food categories namely, non-alcoholic beverages, breakfast cereals and cereal bars found a total of 67% of the products with either a health claim or a nutrient claim. The survey also revealed that 18% of the products contained health claims. Food category wise, 38% of breakfast cereals, 14% of cereal bars and 10% of non-alcoholic beverages carried health claims (Hughes et. al, 2013).

Table 4.2.11: Type of Health Claims declared on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

Health Claims	Total Products	Wheat and oats based products	Bakery Products	Confectionery	Fruit based products	Milk Based	Drinks	Ready to cook/eat products	Food adjuncts	Snacks	Baby Foods
Growth Related (Important for growth, helps increase height)	1.7	0.1	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.9
Weight Related (For weight management)	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helps Reduce Cholesterol	0.5	0.2	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0

Polyols May Have Laxative Effect	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diabetic Friendly	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Not For Phenylketoneurics	0.3	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Heart Related (Good for heart, For healthy heart)	0.8	0.6	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Bones And Teeth Related (For strong bones, muscles and teeth, Strengthens bones and teeth)	0.8	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.2
Memory, Brain And Nervous System Related (For healthy nervous system, For brain development, Supports brain development, For healthy nervous system)	0.9	0.4	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Eyes Related (Good for eyes, For good eyesight)	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Immunity Related (For better immunity, Support the development of baby's immune system)	1.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.8
Healthy Blood Related (Important for healthy boold, For blood formation)	0.5	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
Mental Development Related (Important for mental development)	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Blood Pressure Related (for healthy blood pressure, to maintain blood pressure)	0.3	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Good Skin Related (Good for skin, development of healthy skin)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Low GI	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
For Calorie Conscious	0.3	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.2.11 provides information on declaration of various health claims on the surveyed products. It was observed that the most commonly declared health claim was "growth related" (1.7%). More specifically, to report "growth related" claims manufacturers used short statements like "good for growth", "improves 5 signs of growth bone area, muscles, concentration, active nutrients and healthier blood." Growth related claims were most commonly found in food groups namely, baby foods (0.9%), drinks especially in malted beverages (0.7%) and wheat and oats based products especially in cornflakes, oats and muesli (0.1%). Growth related claims were followed by "immunity related" claims (1%) namely, "for immunity" and "strengthens natural immunity." Such claims were found in baby foods (0.8%) and drinks (malted beverages) (0.2%). The 3rd highest health claim found on the food labels were "memory, brain and nervous system related" (0.9%). It was chiefly found in food groups namely, drinks (malted beverages) (0.5%), wheat and oats based products (cornflakes, oats and muesli) (0.4%). Such claims were usually reported as "for brain development", "supports brain development", "helps improve memory" and "for healthy nervous system". The 4th highest health claim was "heart related" and "bones and teeth related" (0.8% each). Heart related claims were reported as "heart friendly", healthy heart" and "for strong heart" in wheat and oats based products (0.6%), bakery products (0.1%) and milk products (0.1%) while "bones and teeth" related health claims were reported in drinks (0.5%), baby foods (0.2%) and wheat and oats based products (0.1%). The remaining health claims were below 0.5% of the total products. A survey in Sydney, Australia on 1,028 food products from three food categories namely, non-alcoholic beverages, breakfast cereals and cereal bars revealed that 37 different types of health claims were present on food labels. The most common health claims found in Australian products were physical performance related claims e.g. "carbohydrates and electrolytes…… to help you perform at your peak for longer" in non-alcoholic products (n=35), general well-being claims e.g. "nutrients to help maintain your family's wellbeing" in cereal bars (n=18) and energy/vitality claims e.g. "real fruit…… to provide everyday vitality" in breakfast cereals (n=87). Other common health claims were digestion related claims e.g. "high in fibre for healthy digestion", performance related claims e.g. "low GI……to keep your body active and achieve your goals" and hydration related claims e.g. "electrolytes and carbohydrates to provide faster hydration" (Hughes et. al, 2013). In the present study, similar health claims were found. Health claims on food labels are permitted in many countries around the world. Consumers find health claims as useful in making food choices and consider that any product containing the same to be healthy (Williams, 2005). However, it may not be necessary that the health claims

are equally acceptable by the consumers on all products. Studies have shown that health claims on the food products which are perceived as “healthy” (namely, yogurt, juices, honey and low fat foods) was not useful for consumers while health claims on food products which are perceived to be “less healthy” like candies, spreads and mayonnaise were found to have an impact on food choices by the consumers (Ares et. al, 2008; Jesionkowska et. al, 2009; Verbeke et. al, 2009; Ares and Gambaro, 2007; Lyly et. al, 2007). Therefore, protecting consumers from claims on unhealthy products should be a priority for food regulators. Studies have also shown that consumers may misinterpret health claims, especially when scientific language is used to declare the same (Mariotti et. al, 2010).

4.2.5. NUTRIENT CLAIMS

Figure 4.2.13: Nutrient Claims Declared on Food Labels of Processed Packaged Foods in Total Products (in percentage)

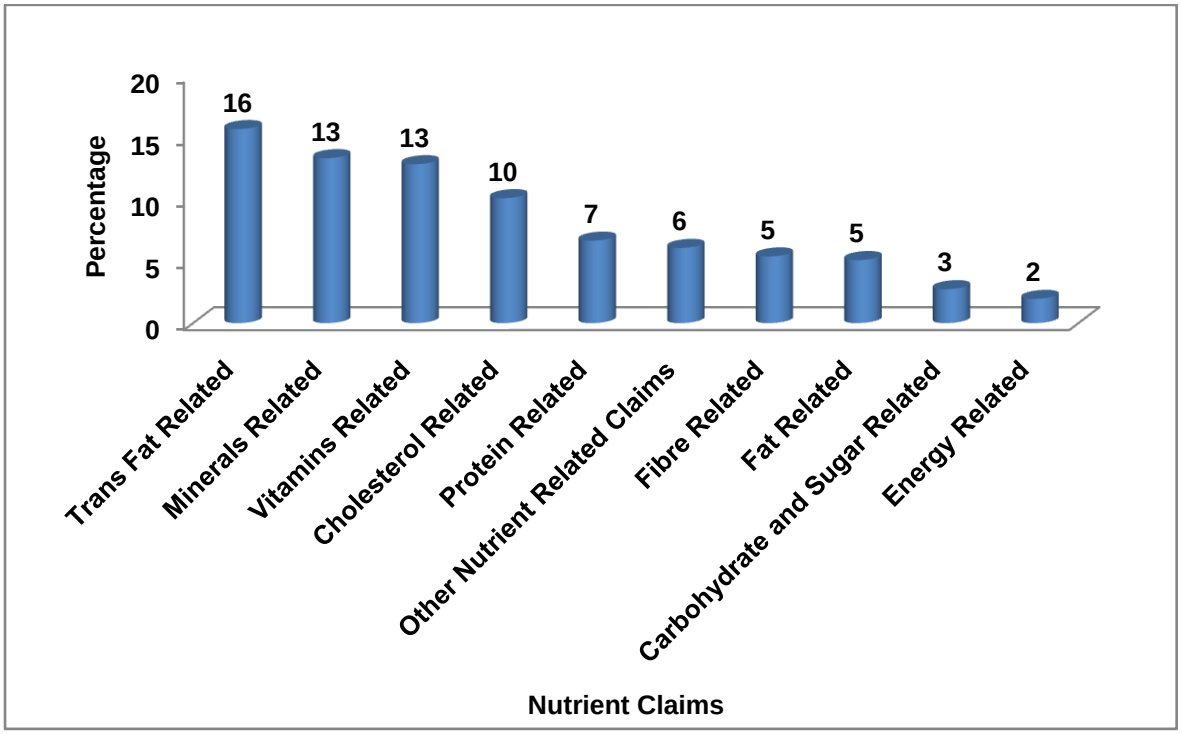


Figure 4.2.13 shows that 16% of the total products had “trans fat” related claims which were followed by vitamins and minerals related claims (13% each). Ten percent of the products had cholesterol related claims and the remaining claims were found in less than 10% of the total products. A study carried out in Hyderabad on 1,219 pre-packaged foods showed that 68% of the surveyed food products carried nutrient claims (Manthena et. al, 2012). An Australian study on 1,028 food products

from three food categories namely, non-alcoholic beverages, breakfast cereals and cereal bars revealed that 65% of the total products contained nutrient claims (Hughes et. al, 2013). In the present study 80% of the total products contained nutrient claims.

Figure 4.2.14: Nutrient Claims Declared on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

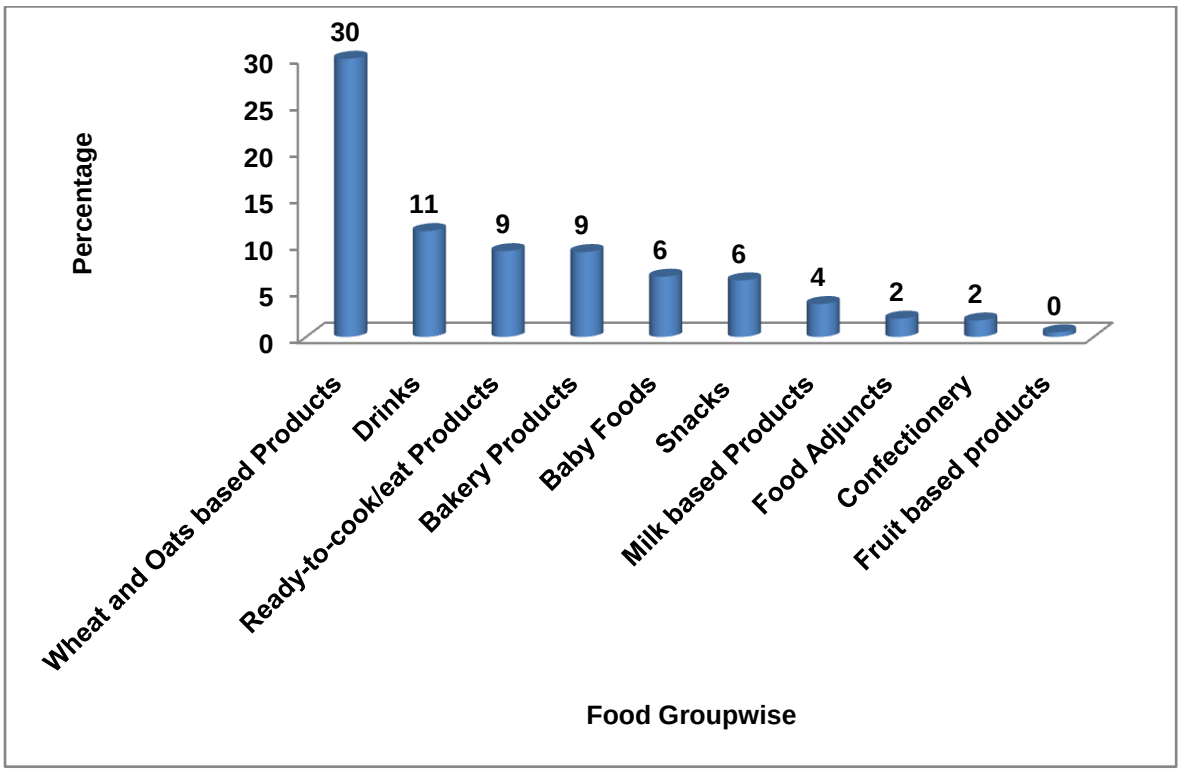


Figure 4.2.14 show that wheat and oats based products carried the highest percentage (30%) of nutrition claims which was followed by drinks (11%), ready to cook/eat products (9%), bakery products (9%), baby foods (6%), snacks (6%), milk based products(4%), food adjuncts (2%), confectionery (2%) and no nutrient claim was found on fruit based products. Similar results were observed in an Australian study, wherein breakfast cereals displayed the highest percentage (83%) of nutrient claims, followed by cereal bars (77%) and non-alcoholic beverages (54%). The study also identified 50 different nutrient claims. The common types of nutrient claims identified were low sugar content or no added sugar on non-alcoholic beverages (n=310), dietary fibre content in cereal bars (n=134) and wholegrain content in breakfast cereal (n=477). Other common nutrient claims across the three categories namely, breakfast cereals, cereal bars and non-alcoholic beverages were for vitamin C content, low fat content and low energy content (Hughes et al, 2013). Table

4.2.12lists various nutrient claims, their types and description used for each type as observed in the present study.

Table 4.2.12: Type of Nutrient Claims Declared on Food Labels of Processed Packaged Foods

Nutrient Claim Category	Type of Claim	Description
Energy Related	Energy	Contain Energy, Source of Energy, High in Energy, Faster Energy, Non-Stop Energy, Provides Adequate Energy
	Calorie	"X%" Less Calorie, Low Calorie
Cholesterol Related		No Cholesterol, Zero Cholesterol, Cholesterol Free, Low Cholesterol
Fat Related	Fat Free	Fat Free, Naturally Fat Free
	"X%" Fat Free	20% Fat Free, 99.7% Fat Free
	Low Fat	_
	Contains Less Than "X%" SFA	Contains less than 15% SFA
Trans Fat Related	Zero TFA	Zero Trans Fat, No Trans Fat, 0% Trans Fat, Trans Fat Free
	Contain Trans Fat	Contain Trans Fat, Bakery Shortening Used-Contains Trans Fat, Hydrogenated Vegetable Fat Used-Contains Trans Fat
Protein Related	_	Contain Protein, Source of Protein, High protein, Good source of Protein, Good Source of Natural Protein, 25% Goodness of Protein, Power of Protein, Rich in Protein,12% RDA of Protein, Wheat Protein, Goodness of Milk Protein, 100% Milk Protein
Carbohydrate and Sugar Related	Complex CHO	Complex Carbohydrates, Excellent Source of Carbohydrates
	Carbohydrates	Contain Carbohydrates, Source of Carbohydrates, High in Carbohydrates, Rich in Carbohydrates
	Sugar	No added sugar, Zero added sugar, "15%" Sugar Free
Fiber Related	_	Contain fiber, Source of fiber, High in fiber, Contain soluble Fiber, Contain Beta-Glucon Soluble Fiber, Extra Dietary Fiber, Good Source of fiber, Goodness of Fiber, Has Fiber, Rich in Dietary Fiber, Natural Wheat Fibers, Enriched with Natural Wheat Fibers, Contain Oligofructose (Dietary Fiber", Fiber "5"g per "60" g of Food)
Vitamins Related	Vitamins	Contain Vitamins, Extra Vitamins, 100% vitamins, Fortified with Vitamins, Enriched with Vitamins

	"X" No. of Vitamins	"22" vitamins, "9" essential vitamins, "22" Power vitamins, "15" Vital Vitamins, Power Packed with "22" Vitamins, Enriched with 9X" Essential Vitamins
	Vitamin A	Contain Vitamin A, Source of Vitamin A, High in Vitamin A, "5%" RDA of Vitamin A, Enriched with Vitamin A
	Vitamin C	Contain Vitamin C, Source of Vitamin C, High in Vitamin C, "5%" RDA of Vitamin C, Enriched with Vitamin C, Rich, >100% RDA of Vitamin C
	Vitamin D	Contain Vitamin D, Source of Vitamin D, Enriched with Vitamin D
	B-Group Vitamins	Contain B1 and B2, High in Vitamin B1,B2,B3,B6,B7,B8,B12
	Folate	Contain Folate, Source of Folate, High in Folate
Minerals Related	Minerals	Contain Minerals, Source of Minerals, High in Minerals, Rich in Minerals ,Fortified with Minerals, Enriched with Minerals, Real Minerals
	"Y" No. of Minerals	5 Essential Minerals, Enriched with 5 Minerals, Power Packed with 11 Minerals
	Calcium	Contain Calcium, Source of Calcium, High in Calcium, Rich in Calcium, Extra Calcium, Calcium Shakti, Calcium Enriched, 11% Calcium, 20% RDA of Calcium
	Iron	Contain Iron, Source of Iron, High in Iron, Enriched with iron, Fortified with Iron, Iron Shakti, Iron Zor, 15% RDA of Iron
	Zinc	Contain Zinc, Source of Zinc
	Magnesium	High in Magnesium
	Phosphorus	High in Phosphorus
	Iodine	Contain Iodine
Other Nutrient Related Claims	Not A Significant Source Of "X", "Y", "Z"	Not a significant Source of Vitamins/Vitamin A/ Vitamin C/Minerals/Iron/Calcium/Sodium/Cholesterol/ Dietary Fiber/ Protein/Calories from Fat, SFA,MUFA,PUFA,TFA
	20+ Important Nutrients	_
	Antioxidants	Lycopene (natural antioxidant), Natural Source of antioxidant, Naturally Contain Lycopene
	Phytonutrients	Contain Phytonutrients

"Nutrient claim means any representation which states, suggests or implies that a food has particular nutritional properties which are not limited to the energy value but include protein, fat carbohydrates, vitamins and minerals." Some of the authorized nutrition claims are "free of fat/ saturated fat/cholesterol/sodium/salt/sugars and

calories", "very Low in sodium", "high or good source of calcium", etc.(FSSAI, 2011). Nutrient claims can be related to presence or absence of a particular nutrient, such as "contain trans fat" or "trans fat free." Table 4.2.13 show food group-wise percentage reporting of various nutrient claims on food labels.

Table 4.2.13: Nutrient Claims Reported on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

Nutrient Claim Category	Type of Claim	Total Products	Wheat and oats based products	Bakery Products	Confectionery	Fruit based products	Milk based products	Drinks	Ready-to-cook/eat products	Food adjuncts	Snacks	Baby Foods
Energy Related	Energy	1.4	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.7
	Calorie	0.6	0.0	0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.0
Cholesterol Related	Low Cholesterol	1.4	0.0	0.0	0.0	0.0	0.1	0.0	1.3	0.0	0.0	0.0
	No Cholesterol	8.7	3.8	1.1	0.0	0.0	1.0	0.5	0.5	0.0	1.9	0.0
Fat Related	Fat Free	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
	"X%" Fat Free	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0
	Low Fat	3.7	0.9	0.3	0.0	0.0	0.1	0.2	2.0	0.0	0.3	0.0
	Contains Less Than "Y%" SFA	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Trans Fat Related	Zero TFA	10	2.4	1.2	0.0	0.0	1.7	0.0	1.7	0.7	2.5	0.0
	Contain Trans Fat	5.6	0.7	2.5	1.6	0.0	0.0	0.0	0.8	0.0	0.0	0.0
Protein Related	Contain Protein	6.7	4.2	0.3	0.0	0.0	0.3	0.9	0.0	0.0	0.2	0.8
Carbohydrate and Sugar Related	Complex CHO	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Carbohydrates	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No Added Sugar	1.9	0.4	0.4	0.0	0.0	0.0	1.0	0.0	0.1	0.0	0.0
Fiber Related	Contain Fiber	5.4	4.4	0.7	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0
Vitamins Related	Vitamins	1.4	0.4	0.2	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
	"X" No. of Vitamins	2.0	0.9	0.6	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1
	Contains Vitamin A	2.0	0.3	0.0	0.0	0.0	0.1	0.9	0.0	0.0	0.0	0.7

	Contains Vitamin C	3.1	1.1	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.7
	Contains Vitamin D	1.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.7
	Contain B Group Vitamins	2.5	1.5	0.1	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0
	Contains Folate	1.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Minerals Related	Minerals	1.5	0.7	0.1	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0
	"Y" No. of Minerals	1.2	0.6	0.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
	Contain Calcium	4.6	1.8	0.2	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.7
	Contains Iron	4.9	3.1	0.5	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.7
	Contains Zinc	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.7
	High Magnesium	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	High Phosphorus	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Iodine	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Other Nutrient Related Claims	Not a Significant Source of "X", "Y", "Z", etc	4.9	0.1	0.0	0.1	0.3	0.1	0.0	3.0	1.0	0.3	0.0
	20+ Important Nutrients	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
	Antioxidants	0.4	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
	Phytonutrients	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

It can be seen from Table 4.2.13 that top 3 food groups declaring "trans fat" related claims were bakery products (3.7%), wheat and oats based products (3.1%) and snacks (2.5%). Of the two kind of TFA related claims as given in Table 4.2.13"Zero TFA" claim was most common (10%) followed by "Contain trans fat" claim (5.6%).

"Vitamins" related claims were found in 5 food groups namely, cereal based products (5%), drinks (4.5%), baby foods (2.2%), bakery products (1%) and milk based products (0.2%). The most common vitamin related claim was "Vitamin C" related (3.1%).

Thirteen percent of the total products had "Minerals" related claims (Figure 4.2.14). Minerals related claims were found in wheat and oats based products (6.4%), drinks

(3.5%), baby foods (2.2%) and bakery products (1.3%). Most common mineral related claim was “Contains Iron” (4.9%).

“Cholesterol” related claim was found in wheat and oats based products (3.8%), bakery products (1.1%), milk based products (1.1%), drinks (0.5%), ready to cook/eat foods (1.8%), snacks (1.9%). Most common was “no cholesterol” claim (8.7%).

“Protein” related claim (6.7%) was most commonly found in wheat and oats based products (4.2%), followed by drinks (0.9%), baby foods (0.8%), bakery (0.3%), milk based (0.3%) and snacks (0.2%).

Other nutrient claims were found in 6.1% of the total products of which 4.9% products had the claim “not a significant source of X, Y, Z.” Baby foods had 0.7% of the claims saying “20+ important nutrients”, wheat and oats based products had claims like “not a significant source….”(0.1%), contain antioxidants (0.2%) and contain phytonutrients (0.1%).

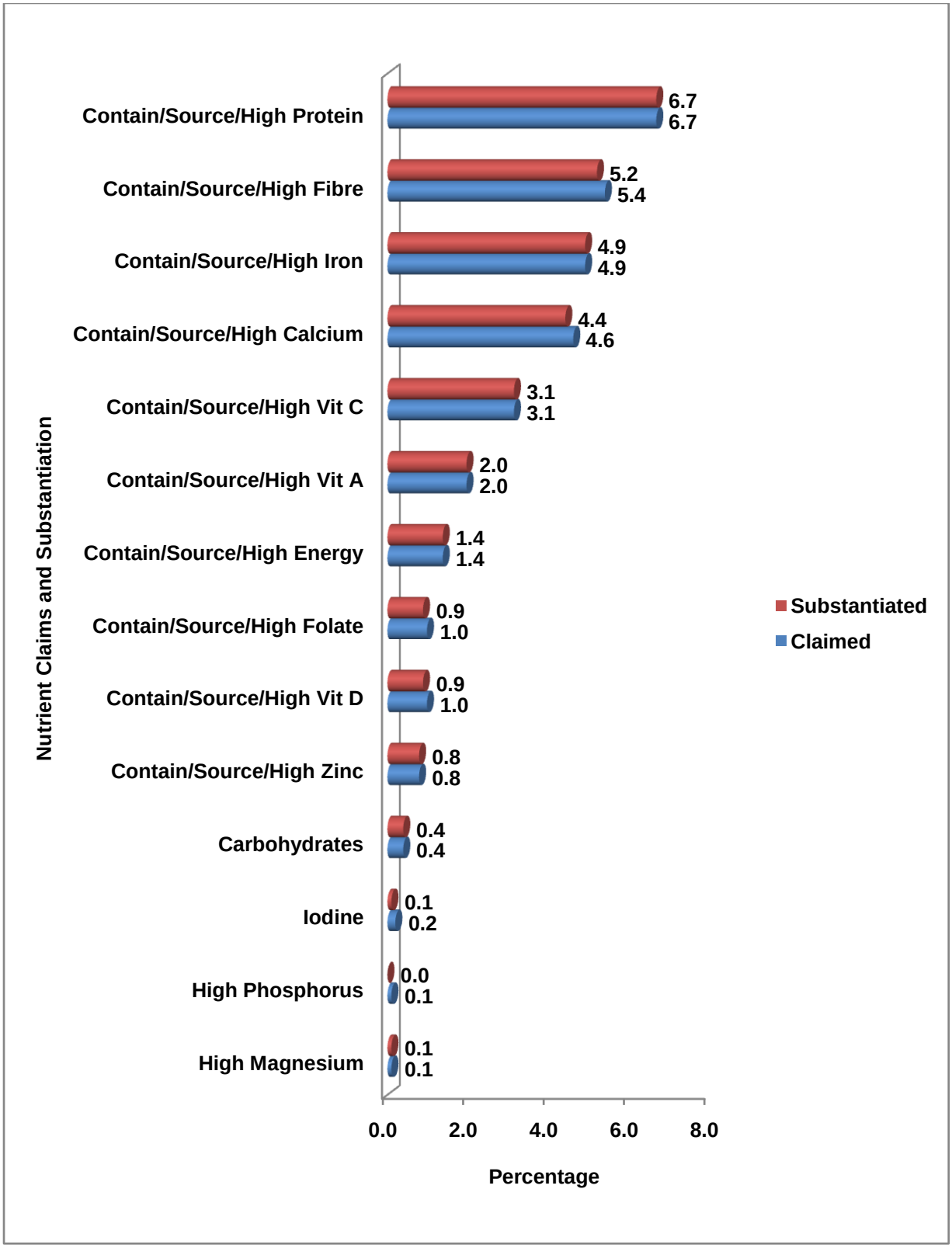
“Fiber” related claims were displayed on food labels as “Contain fiber.” Such claim was found on 5.4% of the products of which 4.4% were wheat and oats based products, 0.7% by bakery products, 0.2% by snacks and 0.1% by drinks.

“Fat” related claims were found in 5.1% of the products of which 1.4% belonged to wheat and oats based products, 2% ready to cook/eat products, 0.8% snacks, 0.5% drinks, 0.3% bakery products, 0.1% each belonged to milk products and food adjuncts. “Low fat” claim was highest (3.7%) among all fat related claims as given in the Table 4.2.13.

“Carbohydrates and sugar” related claims were displayed in 2.7% of the products of which “no added sugar” claim (1.9%) was most common. Wheat and oats based products and drinks each had 1% of the total products displaying “Carbohydrates and sugar” related claims followed by bakery products (0.7%) and food adjuncts (0.1%).

“Energy related” claims (2%) were found in baby foods (0.7%), followed by drinks (0.4%), wheat and oats based products (0.3%), fruit and snacks(0.2% each), bakery and milk products (0.1% each). “Provides energy” claim was most commonly found (1.4%) energy related claim.

Figure 4.2.15: Reporting and Substantiation of Nutrient Claims by NFP (in percentage)



According to FSSA, when a nutrient claim is made on the food product then it is mandatory to report the quantity of that particular nutrient along with five mandatory

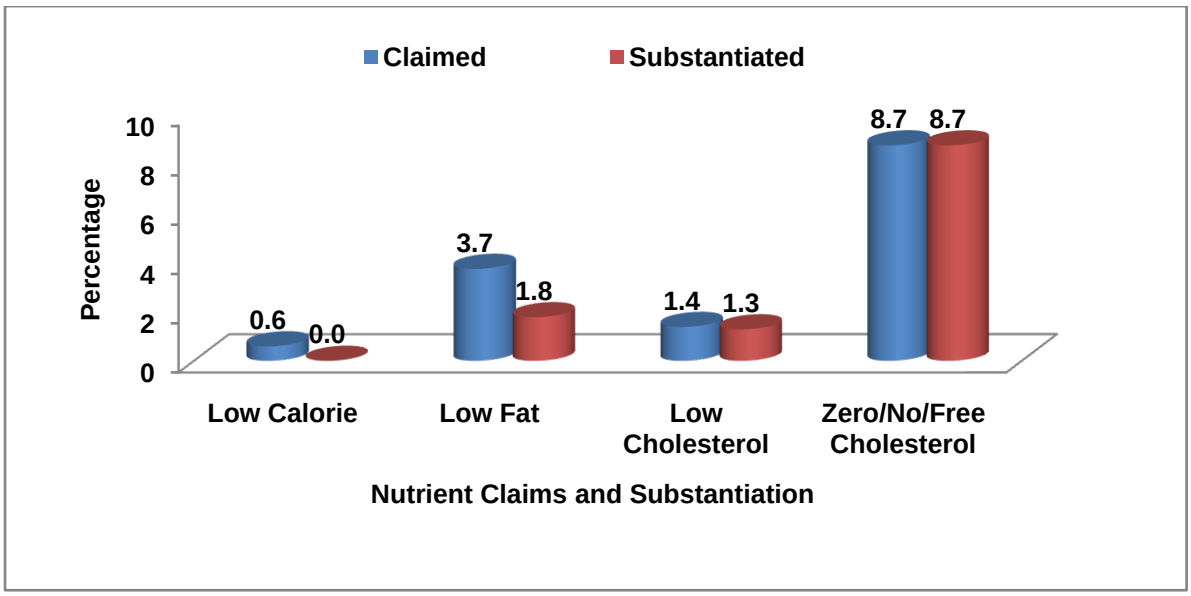
nutrients on NFP (FSSA, 2011). This is called substantiation of the claims. Figure 4.2.15 depicts the nutrient claims and their substantiation for the nutrients which were present/high in the food products. Most of the nutrient claims made were substantiated except for calcium and fiber, wherein 0.2% of the products did not substantiate the claims. Nutrient claims related to Vitamin D, Folate, Phosphorus and Iodine, were not substantiated by 0.1% of the products that claimed the same. However, no difference in claiming and substantiation was found in nutrient claims related to Energy, Protein, Vitamin A, Vitamin C, Iron, Zinc and Phosphorus.

According to Codex (CAC/GL 23-1997), when a nutrient content claim is made on any product, the conditions specified in the Table 4.2.14 for that claim should apply.

Table 4.2.14: Conditions for Nutrient Content Claims as per Codex Alimentarius (CAC/GL 23-1997)

Nutrient Content Claim	Conditions (not more than)
Low Calorie	40 Kcal/100g or 20 Kcal/100ml
Low Fat	3 g/100g or 1.5g/100ml
Low Cholesterol	0.005g/100g or ml
Sugar free/No sugar	0.5g/100g or ml

Figure 4.2.16: Substantiation of Nutrient Claims by NFP according to Codex Alimentarius Guidelines (in percentage)



For the substantiation of Nutrient Content Claims (Figure 4.2.16) each claim on the label was verified against NFP to ascertain if the conditions prescribed by Codex were met for low calorie, low fat and low cholesterol claims. The difference in claim and substantiation for low calorie, low fat and low cholesterol claims was 0.6%, 2% and 0.1%, respectively. However, zero cholesterol claim was substantiated in all the products.

Figure 4.2.17: Substantiation of Nutrient Claims by NFP and Ingredients List (in percentage)

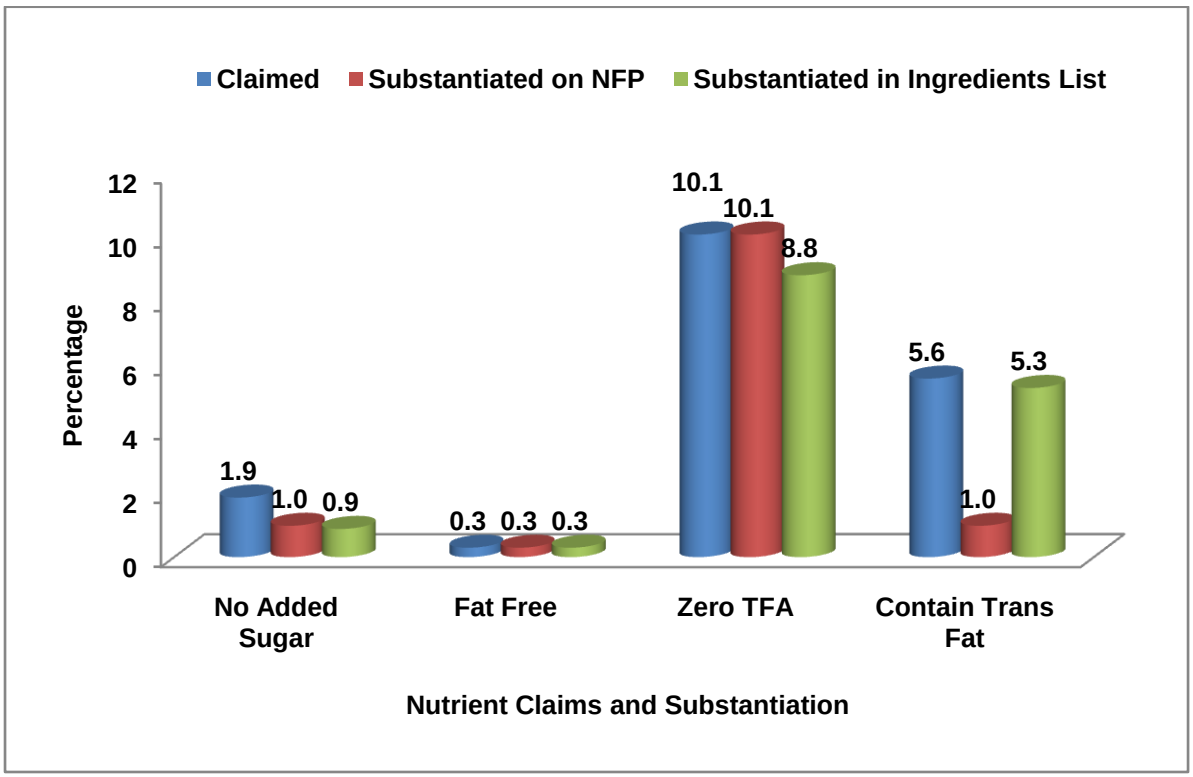


Figure 4.2.17 presents nutrient claims which were substantiated by NFP as well as by Ingredients list. “Fat free” claim was completely substantiated by NFP and Ingredients list. However, “Zero TFA claim” was substantiated by NFP but not by ingredients list (claimed=10.1%, substantiation in ingredients list=8.8%). “No added sugar” and “Contain Trans Fat” claims were not completely substantiated by NFP and ingredients list.

4.2.6. INGREDIENT CLAIMS

Figure 4.2.18: Ingredient Claims Declared on Food Labels of Processed Packaged Foods in Total Products (in percentage)

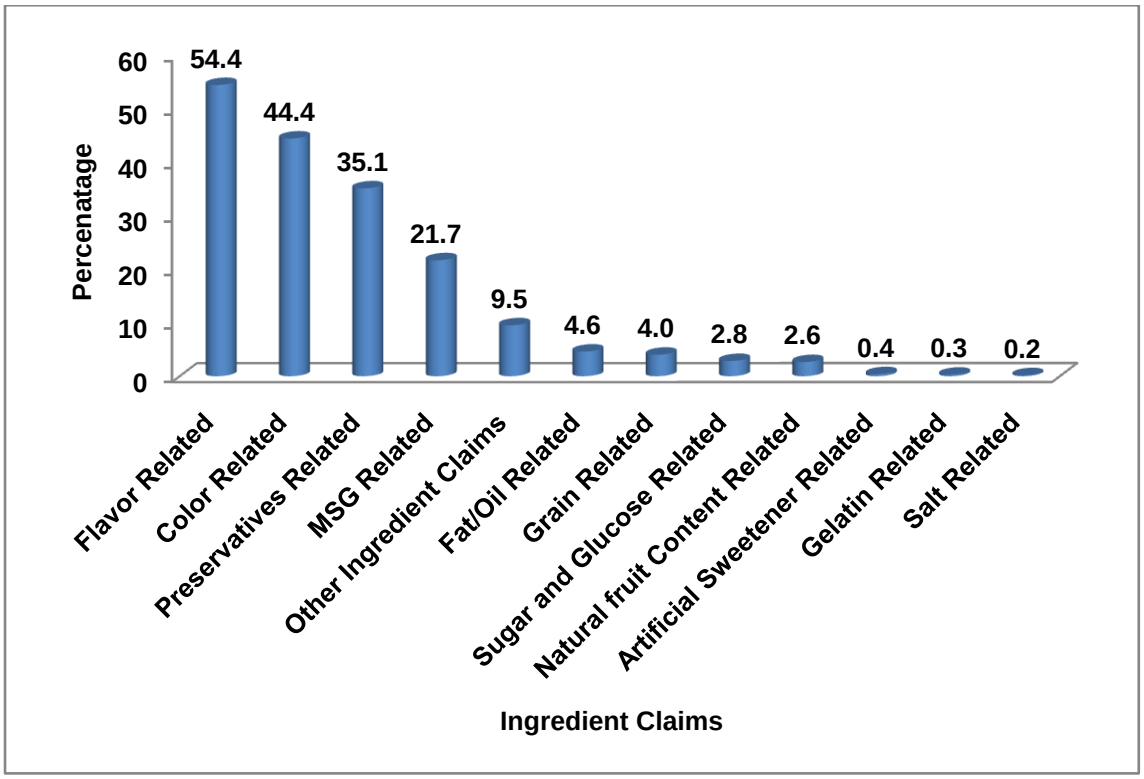


Figure 4.2.18 show that 54% percent of the total products had flavor related claims, followed by color related claims (44.4%), preservatives related claims (35.1%), MSG related claims (21.7%), other ingredient claims (9.5%), fat/oil related claims (4.6%), grain related claims (4%), sugar and glucose related claims (2.8%), natural fruit content related claims (2.6%), artificial sweetener related claims (0.4%), gelatin related claims (0.3%) and salt related claims (0.2%). Food group-wise distribution of ingredient claims has been given in Table 4.2.15.

Table 4.2.15: Ingredient Claims Declared on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

Ingredient Claim Category	Type of Ingredient Claims	Total Products	Wheat and oats based products	Bakery Products	Confectionery	Fruit based products	Milk Based	Drinks	Ready-to-cook/eat products	Food adjuncts	Snacks	Baby Foods
Fat/Oil Related	No Hydrogenated Fats	4.2	0.0	0.4	0.1	0.0	0.0	0.0	3.7	0.0	0.0	0.0
	X% Less Oil	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
	Contain Vegetable Oils	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Salt Related	No Added Salt	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low In Salt	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MSGRelated	No Added MSG	20.4	3.4	0.4	0.0	0.0	0.0	0.0	14.6	0.1	1.9	0.0
	Contain MSG	1.3	0.4	0.0	0.0	0.0	0.1	0.0	0.7	0.1	0.0	0.0
Sugar and Glucose Related	Added Sugar	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
	Enriched With Glucose	2.5	0.0	1.1	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0
Artificial Sweetener Related	No Artificial Sweetener	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Contains Artificial Sweetener	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Preservatives Related	Contain Preservatives	10.1	0.1	0.0	0.0	2.0	1.0	1.3	0.6	5.2	0.0	0.0
	No Preservatives	25.0	0.8	0.3	0.0	0.6	0.0	3.2	18.6	0.2	0.8	0.5
Color Related	Contains Permitted Natural Color	24.2	3.4	3.7	0.5	3.3	0.3	7.8	3.1	0.4	1.5	0.1

	No Added Color	20.2	0.7	0.5	0.0	0.6	0.0	1.6	14.2	1.0	1.2	0.5
Flavor Related	**Contains Added Flavor**	43.2	6.3	7.2	3.7	3.6	1.0	9.5	5.8	0.3	5.8	0.1
	No Added Flavor	11.2	0.7	0.6	0.0	0.6	0.2	0.9	5.9	0.8	1.1	0.5
Grain Related	**Whole Grain**	2.4	2.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
	Multigrain	1.7	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
Natural fruit Content Related	**Contains No Fruit**	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
	Contains Fruit	1.9	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0
Gelatin Related	**Contains No Gelatin**	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
	Contain Gelatin	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Other Ingredient Claims	**With Natural/Real Ingredients**	9.0	0.4	0.4	0.0	0.4	0.0	0.2	7.6	0.0	0.0	0.0
	No GMO	0.4	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	No Thickeners	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0

It can be seen from the Table 4.2.15 that flavor related claims were highest in ready-to- cook/eat products (11.7%) followed by drinks (10.4%), bakery products (7.7%), wheat and oats based products (7%), snacks (6.9%), fruit products (4.2%), confectionery (3.7%), milk based products (1.2%), food adjuncts (1.1%) and baby foods (0.6%). “Contains flavor” claim was high (43.2%) as compared to “No added flavor” claim (11.2%).

Color related claims were found in 44.4% of the total products out of which 24.2% were “Contains Permitted Natural colors” and 20.2% were “No added color.” Food groups having color related claims were ready-to-cook/eat products (17.4%), drinks (9.4%), bakery products (4.2%), wheat and oats based products (4.1%), fruit based products (3.9%), snacks (2.6%), food adjuncts (1.4%), baby foods (0.6%),

confectionery (0.5%) and milk based products (0.3%). “Contains permitted natural color” claim was found to be more frequent than “No added color” claims.

Thirty five percent of the products had “preservatives” related claims of which 25% had “no preservatives” claim and 10.1% had “contain preservatives” claim. “Contain preservatives” claim was high as compared to “no preservatives” claim in milk based products (1% versus 0%), food adjuncts (5.2% versus 0.2%) and fruit based products (2% versus 0.6%). Other food categories were low in “contain preservatives” claim as compared to “no preservatives” claim.

Six out of 10 food groups carried MSG related claims. Of the 21.7% MSG related claims, 20.4% were “No Added MSG” claims and only 1.3% were “Contain MSG” claims. It was surprising to note that ready-to-cook/eat products category that included soups had more of “no added MSG” claim (14.6%) than “contain MSG” claim (0.7%) despite the fact that products in soup category had more than one source of MSG in ingredients list with alternative names. “No added MSG” claim was also found in wheat and oats based products (3.4%), snacks (1.9%) and bakery products (0.4%). “Contain MSG” claim was found in ready-to-cook/eat products (0.7%), wheat and oats based products (0.4%), food adjuncts and milk based products (0.1%). Confectionery, fruit based products, drinks and baby foods did not have any MSG related claims.

“Other ingredients” related claims were “with natural/real ingredients” (9%), “no GMO” (0.4%) and “no thickeners”(0.1%). “With natural/real ingredients” claims were largely found in ready-to-cook/eat products (7.6%), followed by wheat and oats based products, bakery products, fruit based products (0.4%each) and drinks (0.2%). “No GMO” claim was found only in bakery products (0.4%) while “no thickeners” claim was found in food adjuncts (0.1%) only .

“Fats/oils” related claims were found in 4.6% of the products of which, “no hydrogenated fats” claims were found in 4.2% of the products while “X% Less oil” and “Contain vegetable oils” claims were found on 0.2% of the products. “No hydrogenated fats” claim was found in ready-to-cook/eat products (3.7%), bakery products (0.4%) and confectionery(0.1%), Contrary to the claims, 8.2% of ready-to-cook/eat products, 5.5% of bakery products and 4.2% of confectionery products listed one or more sources of trans fat in ingredients list. “X% less oil” and “contain vegetable oil” claims were found in snacks (0.2%) and baby foods (0.2%).

Grain related claims were found in 4% of the products of which 2.4% were related to "whole grain" and 1.7% related to "multigrain." Wheat and oats based products (3.2%), snacks (0.7%) and bakery products (0.2%) had grain related claims.

Sugar and glucose related claims were found in 2.8% of the products of which 2.5% was "enriched with glucose" claim and 0.4% was "added sugar" claim. Bakery products (1.1%) and drinks (1.8%) had sugar and glucose related claims.

All the "Natural fruit" related claims were found in products from drinks category (2.6%) only of which 1.9% were "contains fruit" and 0.8% were "contains no fruit."

"Artificial sweeteners" related claims were found on 0.4% of the products of which 0.2% each was for "no artificial sweeteners" and "contain artificial sweeteners" claims respectively. "No artificial sweeteners" claim was made by 0.2% wheat and oats based products while "contain artificial sweetener" claim was found in bakery products and drinks (0.1% each).

Gelatin related claims were found in 0.3% of the total products, of which 0.2% was "contains no gelatin" claim and 0.1% was "contain gelatin" claim and reported in fruit based products only.

Salt related claims were found in 0.2% of the products, where "no added salt" claim (0.1%) and "low in salt" claim (0.1%) was reported in wheat and oats based products only.

Figure 4.2.19: Substantiation of Ingredients Claim by NFP and Ingredients List (in percentage)

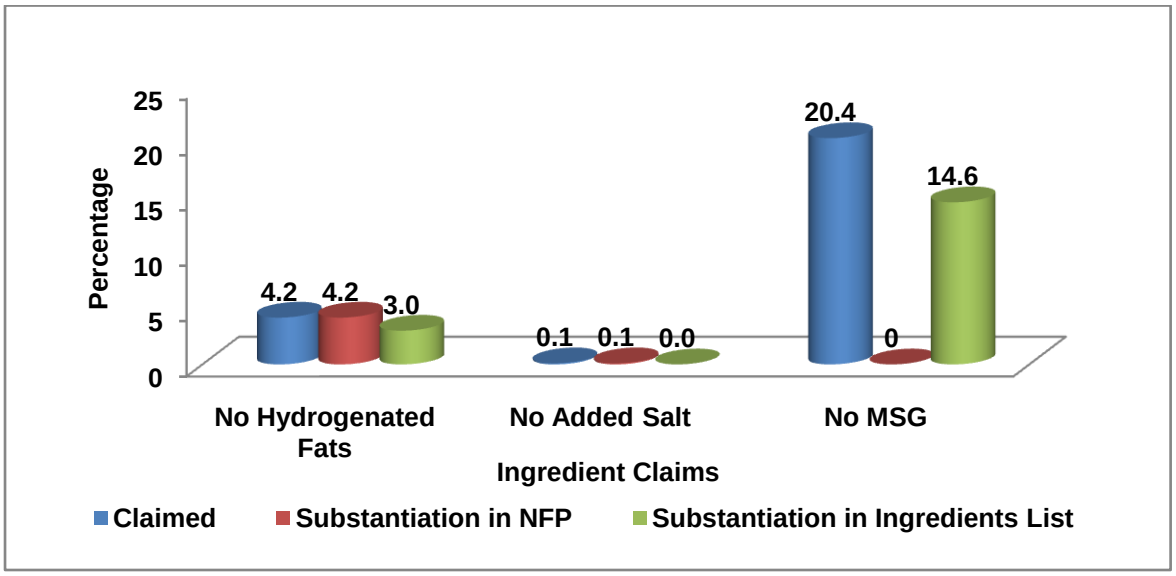


Figure 4.2.19 shows the substantiation of three major ingredient claims by NFP and Ingredients list. “No hydrogenated fat”, “no added salt” and “No MSG” claim were not substantiated by any of the product’s Ingredients list however, they were substantiated by product NFPs i.e. “no hydrogenated fat” was claimed by 4.2% of the products and substantiated by all 4.2% of the product NFPs. Similarly, “no added salt” was claimed and equally substantiated by 0.1% of the products.

Table 4.2.16: Substantiation of “No Hydrogenated Fats” Claim by NFP and Ingredients List in Various Food Groups (in percentage)

Food Groups	Claimed	Substantiation by NFP	Substantiation by Ingredients List
Wheat and oats based products	0.0	0.0	0.0
Bakery Products	0.4	0.4	0.4
Confectionery	0.1	0.1	0.0
Fruit based products	0.0	0.0	0.0
Milk Based	0.0	0.0	0.0
Drinks	0.0	0.0	0.0
Ready-to-cook/eat products	3.7	3.7	2.6
Food adjuncts	0.0	0.0	0.0
Snacks	0.0	0.0	0.0
Baby Foods	0.0	0.0	0.0

Table 4.2.16 shows food group-wise substantiation of “no hydrogenated fat” claim. It was observed that “no hydrogenated fats” claim was not substantiated by ingredients list in confectionery and ready-to-cook/eat products, however it was substantiated by NFP.

Table 4.2.17: Substantiation of “No MSG” Ingredient Claim by Ingredients List in Various Food Groups (in percentage)

Food Groups	Claimed	Substantiated
Wheat and oats based products	3.4	1.0
Bakery Products	0.4	0.0
Confectionery	0.0	0.0
Fruit based products	0.0	0.0
Milk Based	0.0	0.0
Drinks	0.0	0.0
Ready-to-cook/eat products	14.6	12.5
Food adjuncts	0.1	0.1
Snacks	1.9	1.1
Baby Foods	0.0	0.0

Table 4.2.17 shows food group-wise substantiation of “No MSG” claim by ingredients list. It was observed that 14.6% of the ready-to-cook/eat products claimed of being MSG free, however 2.1% of the products had sources of MSG in ingredients list and therefore failed to substantiate the same. Similarly, “No MSG” claim in wheat and oats based products, bakery products and snacks was not completely substantiated by NFP.

Table 4.2.18: Types of Ingredients Claims Reported on Food Labels of Processed Packaged Foods

Ingredient Claim Category	Ingredient Claim Sub-Category	Types of Ingredient Claims
Oil/Fat Related	No Hydrogenated Fats	• No Hydrogenated Vegetable Oil/Fats • No Hydrogenated Fat • No Vegetable Fat
	X% Less Oil	• "X%" Less Oil • Upto "X%" Less Oil
	Contain Vegetable Oils	–
Salt Related	No Added Salt	–
	Low In Salt	–
MSG Related	No Added MSG	• MSG Free • No MSG
	Contain MSG	• Contain Monosodium Glutamate • This Pack Contains Added MSG
Sugar And Glucose Related	Added Sugar	• Quantity of Sugar Added "X" G Per 100g
	Glucose	• Enriched with Glucose • “X%” Pure Glucose • Pure Glucose
Artificial Sweete-ner Related	No Artificial Sweetener	–
	Contains Artificial Sweetener	–
Preservatives Related	Contain Preservatives	• Contain Class II Preservatives • Contain Class II Preservatives(E “ABC”, E”XYZ”) • Contain Permitted Class II Preservatives (E”ABC”, E”XYZ”)
	No Preservatives	• No Added Preservatives • Free from Preservatives • No Preservatives • No Artificial Preservatives • Zero Artificial Preservatives • No Chemical Preservatives • Free from Class II Preservatives

Color Related	Contains Color	• Contains Permitted Food Colors • Contains Permitted Food Colors(E “X”, E”Y”) • Contains Permitted Natural Colors • Contains Permitted Natural Colors (INS “X”, INS”Y”) • Contains Permitted Synthetic Food Colors • Contains Permitted Synthetic Food Colors (INS”X”, INS”Y”)
	No Added Color	• No Color • Zero Color • No Added Color • No Artificial Color • Free From Artificial Color • No Added Synthetic Color
Flavor Related	Contains Flavor	• Contains Added Flavor • Contains Added Flavors-Nature Identical • Added Flavor(Artificial Flavoring Substance-Butter) • Nature And Nature Identical Flavoring Substances • Added Flavors(Nature & Nature Identical Flavoring Substances) • Added “X” Flavor • Permitted And Added Nature And Nature Identical Flavors • Added Artificial Flavoring Substances, • Added Artificial Flavor (Butter/Apple/etc)
	No Added Flavor	• No Flavor • No Added Flavor • Zero Flavor • No Artificial Flavor • Free From Artificial Flavor • No Added Synthetic Flavor
Grain Related	Whole Grain	• Goodness Of Whole Grain • Made From 100% Natural Whole Grain • Made From Whole Grain • Whole Grain Cereal • Whole Wheat • Whole Wheat No Maida
	Multigrain	• Goodness Of Multigrain
Natural Fruit Content Related	Contains No Fruit	• Contains No Fruit • Non-Fruit Product
	Contains Fruit	• 100% Fruit Juice • Fruit Extracts • Fruit Juice And Extract • Mixed Fruit Juice "X%" (Reconstituted) Beverage • Reconstituted "X%" Juice • This Contain "X%" Fruit Juice Content • This Contain Equivalent To "X%" Juice Content • This Is Equal To "X%" Juice Content

Gelatin Related	Contains No Gelatin	_
	Contain Gelatin	• Gelatin-Animal Origin
Other Ingredient Claims	With Natural/Real Ingredients	• All Natural • 100% Natural • 100% Natural Ingredients • 100% Natural Nutrients • 100% Natural Vegetables • Goodness Of Natural Ingredients • 100% Real Chicken • 100% Real Fruits • 100% Real Vegetables • With Real (e.g. "Apple", "Chicken", "Vegetables", Capsicum")
	No GMO	_
	No Thickeners	–

SYMBOLS AND LOGOS

Figure 4.2.20: Symbols and Logos displayed on Food Labels of Processed Packaged Foods in Total Products (in percentage)

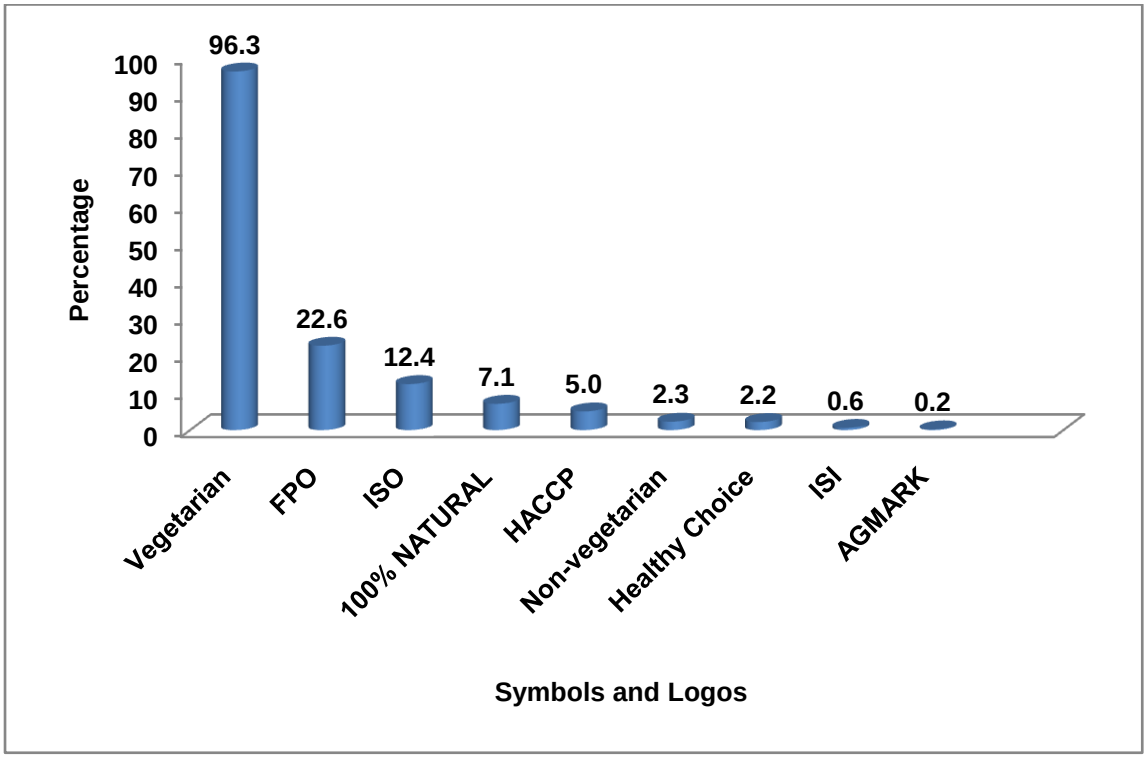


Table 4.2.19: Symbols and Logos Displayed on Food Labels of Processed Packaged Foods in Various Food Groups (in percentage)

Food groups	Vegetarian Symbol	Non vegetarian Symbol	Healthy Choice	ISI	ISO	FPO	AGMARK	HACCP	100% NATURAL
Wheat and oats based products	10.3	0.6	0.3	0.0	0.0	0.4	0.0	0.0	0.0
Bakery Products	13.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Confectionery	3.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fruit based products	4.2	0.1	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Milk based products	3.1	0.3	0.0	0.0	0.2	0.0	0.1	0.0	0.0
Drinks	11.2	0.0	0.0	0.0	1.0	5.2	0.0	0.7	0.0
Ready-to-cook/eat products	26.6	0.7	1.9	0.3	6.7	8.4	0.0	2.6	7.0
Food adjuncts	8.5	0.0	0.0	0.0	1.6	6.6	0.0	0.1	0.0
Snacks	14.6	0.0	0.0	0.0	2.9	0.0	0.1	1.6	0.1
Baby foods	0.5	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0

According to FSSAI, it is mandatory to indicate whether the product contains vegetarian ingredient or non-vegetarian ingredient by means of symbols. Green colored filled circle in a square should indicate vegetarian and brown colored filled circle in a brown color square indicate non-vegetarian food. “Non-vegetarian” food means “an article of food which contains whole or part of any animal including birds, fresh water or marine animals or eggs or products of any animal origin, but excluding milk or milk products, as an ingredient” (FSSAI, 2011). The purpose of these symbols is to give a quick guide or at a glance information about the vegetarian/non-vegetarian ingredients in the food product. All the food products in the present study complied with respect to display of these two symbols.

Various other symbols used by manufacturers on the products which are not mandatory but help in selecting a quality product are Agricultural Marketing symbol (AGMARK), Fruit Product Order symbol (FPO), Hazard analysis Critical Control Point symbol (HACCP), Indian Standards Organization symbol (ISO), Indian Standards

Institute symbol (ISI) and Healthy Choice logo. These symbols and logos help the consumers identify a quality product.

Figure 4.2.20 depicts that majority of the products (98.6%) had either vegetarian or non-vegetarian logo followed by FPO (22.6%), ISO (12.4%), 100% Natural (7.1%), HACCP (5%), Healthy Choice (2.2%), ISI (0.6%) and AGMARK (0.2%). Studies have shown that front-of-pack logo on products can assist consumers in making healthy food choices and thereby reducing the risk of diet related chronic diseases (Grunert and Wills, 2007; Feunekes et. al, 2008; Stockley, 2007; Young and Swinburn, 2002). Several countries have developed their own front-of-pack nutrition logos of varying design and complexity (Vyth et. al, 2009). To name a few, the "Healthier choice tick", "Health protection factor", "Guiding Stars", "Smileys", "Guideline Daily Amounts (GDA)" and "Wheel of Health" are developed and introduced in European nations while "Smart Spot" symbol is most commonly used in the United States, "Shop Smart With Heart" in Canada, "Pick The Tick" belongs to Australia and New Zealand and "Keyhole" is a trademark of Sweden and also followed in Denmark and Norway (Feunekes et. al, 2008).

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MANUFACTURE AND BEST BEFORE DATE

Figure 4.2.21: Format of Labeling "Manufacture (MD) and Best Before date (BB)" on Food Labels of Processed Packaged Foods in Total Products (in percentage)

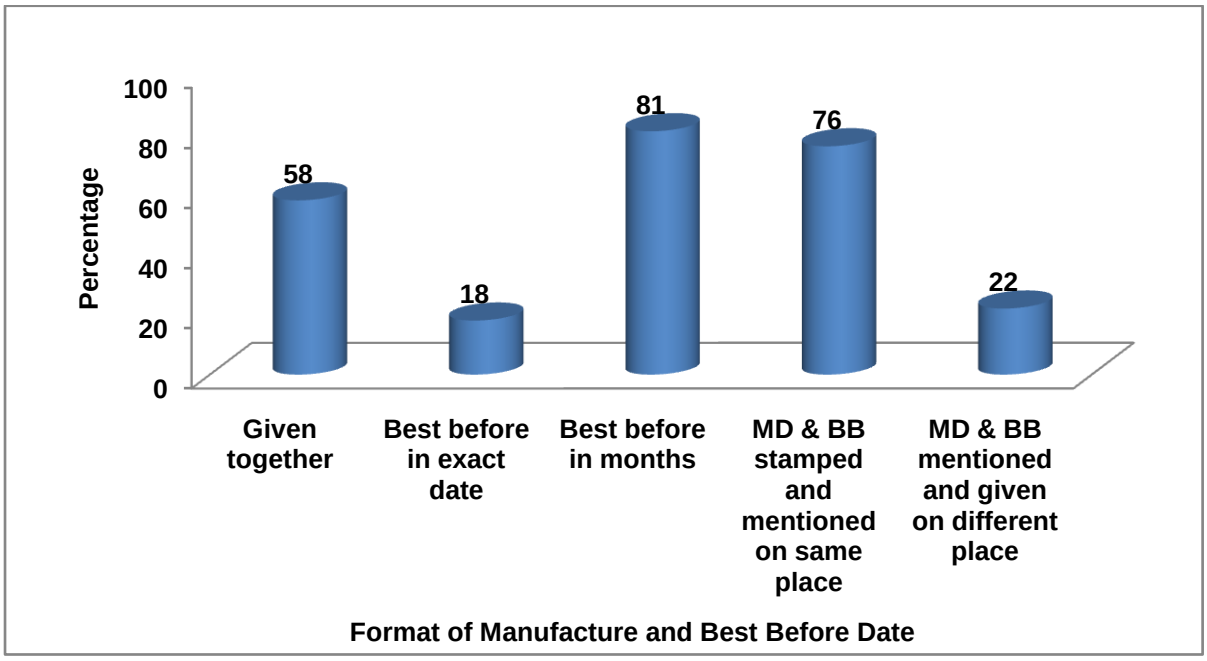


Table 4.2.20: Format of labeling "Manufacture (MD) and Best Before date (BB)" on Food Labels of Processed Packaged Foods from various Food Groups (in percentage)

Food groups	Given together	Best before in exact date	Best before in months	MD & BB stamped and mentioned on same place	MD & BB mentioned and given on different place
Wheat and oats based products	5.1	1.1	9.8	5.8	5.1
Bakery Products	7.6	0.4	13.0	10.5	2.4
Confectionery	1.1	0.0	4.4	3.9	0.5
Fruit based products	2.9	1.6	2.7	3.0	1.3
Milk based products	2.0	0.4	3.0	2.2	1.3
Drinks	2.4	0.2	11.5	3.7	7.4
Ready-to-cook/eat products	20.2	7.9	19.3	25.3	2.0
Food adjuncts	4.4	0.9	7.0	6.5	2.1
Snacks	11.2	4.2	10.2	13.8	0.5
Baby foods	1.2	1.2	0.1	1.2	0.1

According to Codex Alimentarius, Date of Manufacture means "the date on which the food becomes the product as described" and Best Before Date means "the date which signifies the end of the period under any stated storage conditions during which the product will remain fully marketable and will retain any specific qualities for which tacit or express claims have been made. However, beyond the date the food may still be perfectly satisfactory." Table 4.2.20 shows that only 58% of the products declared manufacture and best before date together at the same place. When manufacture and best before date are not given together at a place it makes it difficult and time consuming for the consumers to locate these dates which are the most important quality aspect of any processed food. Another difficulty in these dates is that most of the products (81%) declared best before date in months (i.e. best before in nine months, or best before within 12 months etc.). It is time consuming for the consumers to calculate the best before date from the manufacture date when the

same is given in months. Twenty two percent of the products printed the terms “manufacture date” and “best before date” at one place on the food label and stamped the actual dates elsewhere on the label. Though, FSSA has recommended various formats to declare Best Before and Use by Date/Date of Expiry as mentioned in “Review of Literature” chapter, yet easier to understand and positioning of the dates on the food labels needs to be specified by FSSA.

Phase III-Nutrient Analysis of Selected Processed Foods

Of the 1,020 food products examined for nutrition labeling in Phase-II “Market Survey”, 101 processed packaged foods were selected to carry out the nutrient analysis for the following nutrients-sodium, potassium, sugar, dietary fibre, total fat and fat fractions namely, SFA, MUFA, PUFA and TFA. The analyzed values of each nutrient were compared with the reported values on NFP to calculate the percent variation. The percent variation in values was either declared as over-reporting (reported values >10% of the analyzed values) or under-reporting (reported values <10% of the analyzed values). The detailed procedure of calculating over-reporting and under-reporting has been mentioned in Methods and Materials Chapter.

Table 4.3.1 lists the number of food products selected from each food category for nutrient analysis. Of the 29 food categories, 101 products from 25 categories were shortlisted for nutrient analysis based on the inclusion criteria mentioned in “Chapter 3: Methods and Materials.” None of the food product was selected from food categories namely, energy drinks, squashes, ready to make cake and ice-cream mixes as they did not fit in the inclusion criteria.

Table 4.3.1: Number of Products Selected for Nutrient Analysis from each Food Category

S.No.	Food groups	Food categories	Total Number of products	No. of products selected for nutrient analysis
1	Wheat and oats based products	a. Cornflakes, oats and muesli	46	12
		b. Noodles, pasta and macaroni	66	14
2	Bakery products	a. Salty biscuits	18	2
		b. Sweet biscuits	88	14
		c. Sweet cream wafers	31	1
3.	Confectionery	a. Chocolates	39	10
		b. Cakes	6	1
4	Fruit based products	a. Canned fruits	6	1
		b. Jam, marmalades and jellies	38	2
5	Milk based products	a. Butter and cheese	18	1
		b. Spreads and dips	17	2
6	Drinks	a. Malted beverages	27	3
		b. Soft drinks	13	1
		c. Energy drinks	27	0
		d. Juices	37	1
		e. Squashes	15	0
7	Ready-to-cook/eat products	a. Ready to cook foods	95	2
		b. Ready-to-use spice mixes	99	3
		c. Ready to make cake and ice cream mixes	16	0
		d. Ready to eat sweets	27	1
		e. Soups	41	6
8	Food adjuncts	a. Pickles	18	2
		b. Papads	14	1
		c. Chutneys	6	0
		d. Ketchups and sauces	49	2
9	Snacks	a. Namkeens and savories	107	11
		b. Chips	32	5
		c. Popcorn	10	1
10	Baby foods	a. Cereal and milk based baby foods	14	2
TOTAL			1020	101

Figure 4.3.1: Reporting of "Nutrients of Concern" on NFP of Selected Processed Packaged Foods (in percentage)

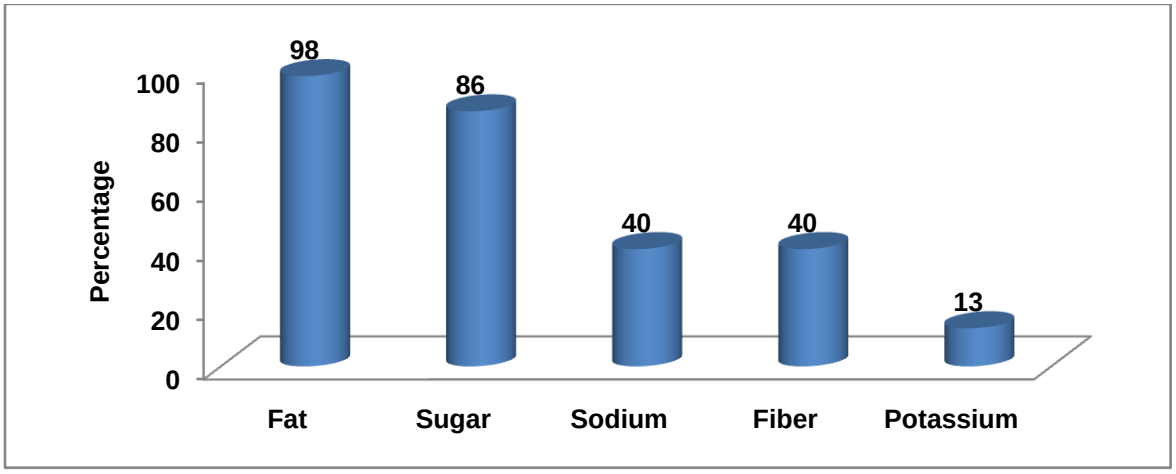


Figure 4.3.1 illustrates percentage reporting of "nutrients of concern" on NFP in selected processed foods (n=101). It can be seen that of the selected 101 products, 98% of the products reported fat, followed by sugar (86%), fiber (40%), sodium (40%) and potassium (13%). Though reporting of "sugar" is mandatory according to FSSA, yet it was not reported in 14% of the products. Reporting of sodium, fiber and potassium is voluntary but due to the associated health risks related to sodium and health benefits related to fiber and potassium, reporting of these nutrients on NFP should be made mandatory.

Figure 4.3.2: Difference in Reported and Analyzed Values of "Nutrients of Concern" in Total Products Selected (n=101) for Nutrient Analysis (in percentage)

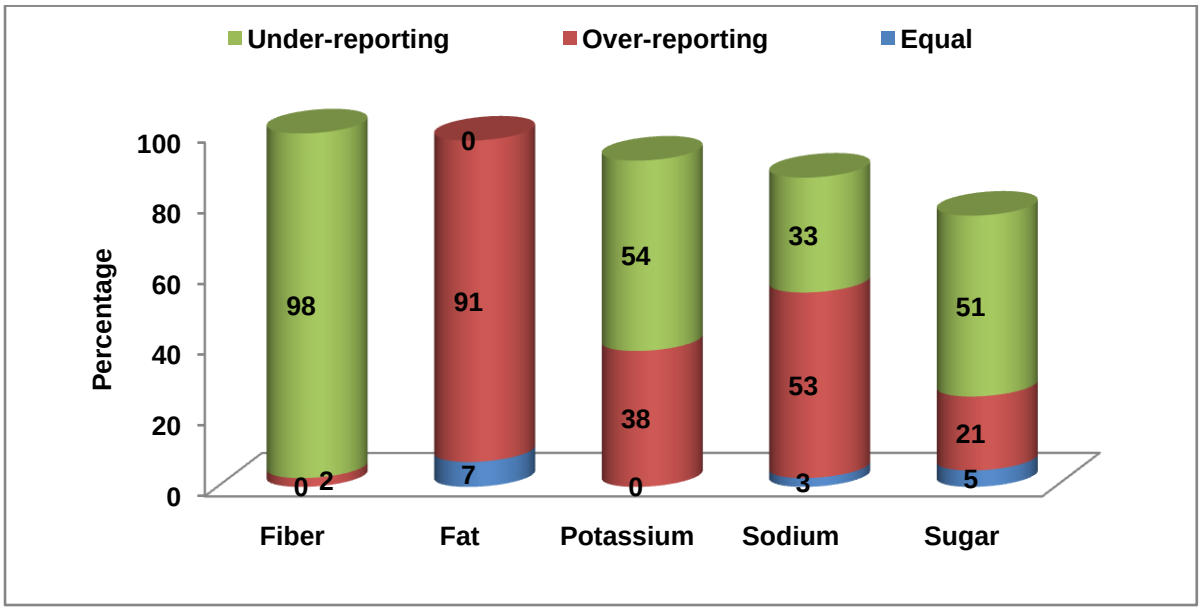


Figure 4.3.2 show the difference in reported and analyzed values of "nutrients of concern." Of the total products analyzed (n=101), 40 products reported fiber content. Of those products that reported fiber content, 98% under-reported the fiber values which can be ascribed to the difference in the analytical methods used. Reported values were that for the "crude fiber" content while analyzed content were for "dietary fiber." The crude fiber content is about 1/7th to 1/2 of the total dietary fiber which could be the probable reason for lower reported values of fiber (Anderson et. al, 2010). Two percent of the products over-reported the fiber values.

Of the total products analyzed, 99 products reported fat content on NFP. Of those reporting fat content, 91% over-reported the fat values while under-reporting was not found in any of the products. Seven percent of the products had similar reported and analyzed fat content. The remaining food products had variation of less than 10% in reported and analyzed values for fat. Similar study by Chandorkar and Joshi (2012), found an over-reporting of fat content in 33% of the packaged food products and under-reporting in 44% of the products.

Increased intake of potassium lowers the blood pressure and thereby has protective effect against heart ailments (He and MacGregor 2001). Therefore, in the present study potassium was analyzed and percent products showing variation in reported versus analyzed values was calculated. Of the total products selected for nutrient analysis (n=101), only 13 products reported potassium content on NFP. Over-reporting was observed in 38% of the products and 54% of the products under-reported the potassium content. One product had less than 10% variation in reported and analyzed values for potassium.

Of the total products (n=101), only 2/5th (n=40) of the products reported sodium values on NFP. Of those that reported sodium content, 34 products were found to be either over-reporting or under-reporting the sodium values. It can be seen from the Figure 4.3.2, that 53% of the products over-reported the sodium values while 33% under-reported the same. Three percent of the products had similar reported and analyzed values for sodium while the remaining products had less than 10% variation in reported and analyzed sodium values. Similarly, study carried out in Vadodara revealed an over-reporting in sodium content by 25% of the analyzed food products and under-reporting in 38% of the food products. Compared to the present study,

study from Vadodara revealed a higher percentage of products (37%) with no variation in reported and analyzed sodium content (Chandorkar and Shah, 2014).

A total of 87 products reported sugar content on NFP wherein under-reporting was found in 51% of the products and over-reporting was observed in 21% of the products. Five percent of the products reported similar sugar content as was analyzed and the remaining products had less than 10% variation in reported and analyzed values for sugar. Thus, the products high in nutrients of concern reported lower values on the food labels and failed to comply with the FSSA labeling guidelines. Similar investigation by Chandorkar and Shah (2014) also showed variation in reported and analyzed sugar values. The study revealed that 44% of the products under-reported the sugar values, while 29% over-reported the same. Twenty seven percent of the products showed similar reported and analyzed sugar content.

Under-reporting is a cause of concern for fat, sugar and salt/sodium as these nutrients when under-reported lead to over-consumption of the same without the knowledge of the consumer. The over-consumption of fat, sugar and salt/sodium are one of the leading risk factors for chronic non-communicable diseases (NCDs) (Stuckler et. al, 2012).

Conversely, over-reporting of potassium and fiber is a matter public health concern as insufficient consumption of potassium and fiber may lead to various health problems. Sufficient consumption of potassium is associated with reduced blood pressure, improved heart and bone health and reduces the risk of stroke and coronary heart disease (Geleijnse et. al, 2003; Weaver, 2013). Similarly, sufficient fiber intake prevents intestinal ailments, such as constipation, hemorrhoids, hiatus hernia, diverticular disease and cancer of the colon. Dietary fiber helps in the prevention and treatment of obesity, reduction of blood cholesterol levels, glycemic regulation after meals and reducing the risk of cardiovascular diseases and diabetes (Marlett et. al, 2002).

Table 4.3.2: Over-reporting, Under-reporting and Mean Sodium Content of Selected Processed Packaged Foods in Various Food categories

Food categories	No. of products	Over-reporting	Under-reporting	Reported (mg/100g)	Analyzed (mg/100g)	t-value
	% (n)	% (n)	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	15 (6)	10 (4)	3 (1)	558±254	357±237	1.422
Noodles, pasta and macaroni	10 (4)	5 (2)	5 (2)	1643±353	1465±490	0.589
Chocolates	5 (2)	5 (2)	0	183±33	160±28	_
Canned fruits	3 (1)	0	3 (1)	1.6	40	_
Jam, marmalades and jellies	3 (1)	0	3 (1)	40	560	_
Butter and cheese	3 (1)	0	3 (1)	786	1600	_
Spreads and dips	3 (1)	0	3 (1)	650	1000	_
Malted beverages	5 (2)	0	0	400±0	420±28	_
Juices	3 (1)	0	3 (1)	40	100	_
Ready to cook foods	5 (2)	3 (1)	3 (1)	1220±1047	1170±1457	_
Ready to eat sweets	3 (1)	3 (1)	0	240	100	_
Soups	15 (6)	8 (3)	3 (1)	6698±3200	5333±1633	0.931
Papads	3 (1)	0	3 (1)	1575	2200	_
Ketchups and sauces	3 (1)	3 (1)	0	1070	700	_
Namkeens and savories	15 (6)	13 (5)	0	748±135	477±209	2.678*
Chips	3 (1)	3 (1)	0	1118	260	_
Popcorn	3 (1)	3 (1)	0	400	200	_
Cereal and milk based baby foods	5 (2)	0	5 (2)	138±32	330±42	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.2 details the variation in sodium values in each food category in terms of over-reporting and under-reporting. Of the total products that reported sodium content on NFP (n=40), majority were from the food categories namely, cornflakes, oats and muesli (15%), soups (15%), namkeens and savories (15%) and noodles, pasta and macaroni (10%). A total of 21 food products over-reported the sodium values of which the top 3 foods were namkeens and savories (13%), cornflakes, oats and muesli (10%) and soups (8%). Under-reporting of sodium was found in 13 food products and majority was from noodles, pasta and macaroni (5%) and cereal and milk based baby food (5%). The remaining food products had either similar or less than 10% variation in reported and analyzed sodium content.

A higher analyzed sodium content than the reported values was found in the food categories namely, papads, butter and cheese, spreads and dips, jam, marmalades and jellies, malted beverages, cereal and milk based baby foods, juices and canned

fruits. The reason for higher analyzed values for sodium than the reported values could be due to the presence of multiple sources of sodium in the ingredients list. On the other hand, lower analyzed sodium values than the reported values in food categories namely, cornflakes, oats and muesli, noodles, pasta and macaroni, chocolates, ready to cook foods, ready to eat sweets, soups, ketchups and sauces, namkeens and savories, chips and popcorn indicate the non-inclusion of MSG, additives and preservatives in calculating total sodium content of the foods.

Studies have revealed that major portion of salt in the diet comes from processed foods. According to a study among Canadians, processed foods were found to contribute about 75% of the total daily sodium intake (Barr, 2010). A study conducted in Canada examined baby and toddler food products and found that over 12% of products had moderate or high levels of sodium (>260 mg per serving=high in sodium) (Elliott, 2010).

Table 4.3.2 also presents the comparison between mean reported and analyzed sodium values. The student t-test revealed a statistically significant difference between reported and analyzed values of sodium in namkeen and savories ($p \leq 0.05$, $t=2.678$). Soups which are marketed as healthy were found to have the highest sodium content (reported=6698 mg/100g, analyzed=5333 mg/100g). Canned fruits had the lowest reported and analyzed sodium values of 1.6 mg/100g and 40 mg/100g, respectively. No significant difference was found between the mean reported and analyzed values for majority of the food products namely, cornflakes, oats and muesli, noodles, pasta and macaroni and soups. A study carried out in Australia showed a lower reported sodium content in breakfast cereals (385 mg/ 100g), soups (1883 mg/100g) and butter (531 mg/100g) as compared to their counterparts from the present study i.e. breakfast cereals (558 mg/100g), soups (6698 mg/100g) and butter (786 mg/100g) (Grimes et. al, 2011).

Table 4.3.3: Food Products "Not Reporting" Sodium Values in Various Food Categories

Food Categories	Not reported % (n)	Analyzed Mean±SD (mg/100g)	Analyzed Range (mg/100g)
Cornflakes,oats and muesli	10(6)	1187±876	40-2000
Noodles,pasta and macaroni	16(10)	1250±346	840-1760
Salty Biscuits	3(2)	520±113	440-600
Sweet Biscuits	23(14)	277±103	120-460
Sweet Cream Wafers	2(1)	60	-
Cakes	2(1)	320	-
Chocolates	13(8)	145±51	100-180
Jam,marmalades and jellies	2(1)	80	-
Spreads and dips	2(1)	520	-
Soft drinks	2(1)	40	-
Malted Beverages	2(1)	300	-
Ready-to-use spice mixes	5(3)	4420±1417	4000-6000
Ketchups and sauces	2(1)	1000	-
Pickles	3(2)	3240±3903	480-6000
Chips	7(4)	570±268	300-800
Namkeens and savories	8(5)	792±365	420-1400

Table 4.3.3 show the products that did not report sodium values but were found to have substantial amount of sodium content when analyzed. Of the total products analyzed for sodium content, 61 did not report sodium values on NFP of which majority of the products were sweet biscuits (23%, range-120 to 460 mg/100g), noodles, pasta and macaroni (16%, range-840 to 1760 mg/100g), chocolates (13%, range-100 to 180 mg/100g), cornflakes, oats and muesli (10%, range-40 to 2000 mg/100g), namkeens and savories (8%, range- 420 to 1400 mg/100g), chips (7%, range- 300 to 800 mg/100g) and ready-to-use spice mixes (5%, range-4000 to 6000 mg/100g). Of those products not reporting sodium values, top 5 food categories having high analyzed sodium values were, ready-to-use spice mixes (4420 mg/100g), pickles (3240 mg/100g), noodles, pasta and macaroni (1250 mg/100g), cornflakes, oats and muesli (1187 mg/100g) and namkeens and savories (792 mg/100g). Chocolates did not list salt/sodium as the major constituent in ingredients list, yet had products with mean analyzed sodium content of 145±51 mg/100g of food. Thus, several products with high sodium content did not report the same on NFP. Therefore, reporting of sodium values should be made mandatory so as to help the consumers make healthy food choices by limiting their daily sodium intake within the recommendations by WHO (2000 mg/day sodium or 5000 mg/day salt for an average adult) (WHO, 2012).A study conducted by WHO (2012a), found that the calculated sodium content of foods namely, snack foods (cheese puffs, popcorn),

butter/margarine and cereal products (bread, breakfast cereals, biscuits, cakes, pastries) were 1500mg, 500mg and 250mg per 100 g of food, respectively. Similar study conducted in Rio de Janeiro, Brazil on the composition of 21 biscuits showed that the analyzed mean sodium content of the salty biscuits ranged from 1040 to 1483 mg/100g and sweet biscuits from 123.8 to 746 mg/100g (Passos et. al, 2013). Analyzed mean sodium content range of both the salty biscuits (440 to 600 mg/100g) and sweet biscuits (120 to 460 mg/100g) in the present study were found to be lower than the Brazilian biscuits.

Data presented in the Table 4.3.2 and Table 4.3.3 indicate a higher range of analyzed sodium content (40 to 5333 mg/100g) as compared to a similar investigation carried out in Delhi, India wherein the sodium content in the analyzed food products ranged from 200 to 4200 mg/100g. However, analyzed sodium content of comparable products in the present study namely, noodles, pasta and macaroni (1465 mg/100g) and chips (570 mg/100g) were lower than the study from Delhi wherein the sodium content of noodles ranged from 3200 to 4200 mg/100g and chips ranged from 1200 to 3500 mg/100g. Sodium content of the other unpackaged junk foods in the study from Delhi were, vegetarian burgers (1700 mg/100g), non-vegetarian burgers (1500 mg/100g), pizza (1000 mg/100g), fries (400 mg/100g) and fried chicken (900 mg/100g) (Johnson et. al, 2012)

Study on sodium content of processed foods (n=7,221) carried out in Australia found that the highest sodium content was in sauces and spreads (1283 mg/100g) and processed meats (846 mg/100 g) while cereal and cereal products (206 mg/100 g) and fruit and vegetables (211 mg/100 g) were lowest in sodium content (Webster et. al, 2010). In the present study, cereal products i.e. cornflakes, oats and muesli had higher mean reported and analyzed sodium content of 558 mg/100g and 1187 mg/100g, respectively than those reported in the Australian study. Of the two products from spreads and dips that were analyzed for sodium values, only one product reported sodium values and it was found to have higher reported and analyzed sodium values i.e. 650 mg/100g and 1000 mg/100g, respectively than those reported in the Australian study. The food products analyzed in the present study revealed a higher sodium content than their counterparts from the other countries. Similarly, study from UK reported lower sodium content in the comparable products from the present study. Sodium content in breakfast cereal without nuts was 41 mg/100g of food followed by mayonnaise (131 mg/100g of food), muesli type cereal with nuts (138 mg/100g of food), potato chips (193 to 599mg/100g of food),

low fat spreads (482 to 692mg/100g of food), butter (467 to 484 mg/100g of food), margarine (878 g/100g of food) and instant soup (2376 mg/100g of food)(Department of Health-UK, 2013). A study conducted in UK on 44,372 food products revealed that the largest contributors to sodium were table salt (23%), processed meat (18%), bread and bakery products (13%), dairy products (12%) and sauces and spreads (11%). Food groups with the highest mean sodium content were sauces and spreads (1090 mg/100 g), snack foods (739 mg/100 g) and processed meats (590 mg/100 g). Processed vegetables had the lowest mean sodium content (195 mg/100 g) (Mhurchu et. al, 2011).Similarly, largest contributors to sodium intake among Australian Children (aged 2-16 years, n=4487) were cereals and cereal based products and dishes (43%), meat and poultry (16 %), milk products and dishes (11 %) and savoury sauces and condiments (7 %) (Grimes et. al, 2011). Thus, processed packaged foods in India need to be reformulated to reduce the sodium content as is done in various developed countries.

Table 4.3.4: Over-reporting, Under-reporting and Mean Potassium Content of Selected Processed Packaged Foods in Various Food categories

Food categories	No. of products	Over-reporting	Under-reporting	Reported (mg/100g)	Analyzed (mg/100g)	t-value
	% (n)	% (n)	% (n)	Mean±SD	Mean±SD	
Noodles, pasta and macaroni	15(2)	8(1)	8(1)	211±150	210±71	_
Canned fruits	8(1)	8(1)	0	87.3	60	_
Malted beverages	15(2)	8(1)	0	705±304	560±57	_
Juices	8(1)	8(1)	0	70	20	_
Ready to eat sweets	8(1)	0	8(1)	120	180	_
Soups	31(4)	8(1)	23(3)	241±145	390±271	0.97
Cereal and milk based baby foods	15(2)	0	15(2)	443±4	540±28	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.4elicits information on the variation in reported and analyzed potassium values. Of the 101 products analyzed, only 13 products reported potassium content on NFP, of which soups had the highest percentage of products (23%) under-reporting the potassium content followed by cereal and milk based baby foods (15%), ready to eat sweets (8%) and noodles, pasta and macaroni (8%). The present study showed a lower range of potassium content (70 to 705 mg/100g) when compared to the products from US (0 to 920 mg/100g). The investigation from US (n=6,560) revealed that only 10% of the products reported potassium content and they were from the food categories namely, vegetable juices, seasoned processed potatoes,

instant hot cereal, french toast, pancakes and waffles and sauces (Curtis et. al, 2013).

Eight percent of the products from each food category namely, noodles, pasta and macaroni, canned fruits, malted beverages, juices and soups over-reported the potassium values. Mean reported and analyzed potassium content of the food categories did not vary significantly. Analyzed mean potassium content in noodles, pasta and macaroni, canned fruits, malted beverages and juices was found to be lower than the reported values. However, mean analyzed potassium values were found to be higher than the reported values in food categories namely, ready to eat sweets, soups and cereal and milk based baby foods.

In the present study, cereal and milk based baby foods had lower sodium content (reported=138 mg/100g, analyzed=330 mg/100g) than potassium content (reported=443 mg/100g, analyzed=540 mg/100g). Malted beverages too had lower sodium content (reported=400 mg/100, analyzed=420 mg/100g) than potassium content (reported=705 mg/100g, analyzed=560 mg/100g). Similarly, analyzed mean values of potassium were found to be higher than the reported values in soups and cereal and milk based baby foods. Noodles, pasta and macaroni were low in potassium content and considerably higher in sodium content, thereby making them unhealthy for consumption.

WHO has recommended an optimum safe sodium intake of <2000 mg/day or 5 g/day salt and potassium at least 3510 mg/day intake by adults (≥16 years). The recommended sodium and potassium intake should be adjusted downward for children (2-15 years), based on the energy requirements of children relative to those of adults. Though the optimal sodium to potassium ratio has not been derived by WHO but an increased potassium intake and decreased sodium intake is strongly recommended (WHO, 2012b). Studies have reported that potassium to sodium ratio is an important factor in cardiovascular disease and mortality. Higher potassium to sodium intakes has stronger effects on blood pressure and the risk of consequent cardiovascular disease than either sodium or potassium alone (Cook et. al, 2009). A consumer study carried out in US revealed that lower potassium to sodium intake ratios were associated with increased cardiovascular and ischemic heart disease (HRs of 1.46, 1.46, and 2.15, respectively) (Yang et. al, 2011). A long term randomized controlled trial (RCT) among elderly veterans showed that a combination

of increased potassium and decreased sodium intake had beneficial effect on cardiovascular mortality and medical expenses related to CVD (Chang et. al, 2006). High dietary potassium is associated with a decrease in blood pressure, particularly in the context with high-sodium diet (Weaver, 2013). A high potassium intake has been found to have defensive effects against various pathological conditions that affect the cardiovascular system, kidneys and bones. Increased potassium intake helps in reducing urinary calcium excretion leading to positive bone health and preventing the risk of osteoporosis (Lanham-New and Lambert, 2012). A lower sodium content than the potassium content is desirable for good health, however in the present study, 72% of the products had higher analyzed sodium content than the analyzed potassium content, thus indicating unfavorable potassium to sodium ratio in majority of the products.

Table 4.3.5: Food Products "Not Reporting" Potassium Values in Various Food Groups

Food Categories	Not Reported % (n)	Analyzed Mean±SD (mg/100g)	Analyzed Range (mg/100g)
Cornflakes,oats and muesli	14(12)	218±75	100-300
Noodles, pasta and macaroni	14(12)	323±118	160-560
Salty Biscuits	2(2)	130±71	80-180
Sweet Biscuits	16(14)	146±47	80-240
Sweet Cream Wafers	1(1)	220	_
Cakes	1(1)	140	_
Chocolates	11(10)	166±50	80-240
Jam, jelly and marmalades	2(2)	130±99	60-200
Butter and cheese	1(1)	0	_
Spreads and dips	2(2)	20±28	0-40
Soft drinks	1(1)	20	_
Malted beverages	1(1)	520	_
Ready to cook foods	2(2)	990±863	380-1600
Soups	2(2)	390±269	200-580
Ready-to-use spice mixes	3(3)	760±92	680-860
Ketchups and sauces	2(2)	250±42	220-280
Pickles	2(2)	130±99	60-200
Papads	1(1)	760	_
Chips	6(5)	696±234	360-960
Namkeens and savories	13(11)	424±236	120-740
Popcorn	1(1)	200	_

Table 4.3.5 presents data on the products that did not report potassium content on NFP. Of 101 products analyzed, 88 products did not report potassium content on NFP, of which 16% of the sweet biscuits did not report potassium content followed by cornflakes, oats and muesli (14%), noodles, pasta and macaroni (14%), namkeens and savories (13%) and chocolates (11%). Potassium content in these food

categories ranged from 0 to 1600 mg/100g. A similar investigation carried out in US on 6,560 packaged food products revealed that 92.4% of the products did not report potassium content on the NFP (Curtis et. al, 2013). The reason for not reporting potassium content on the food products may be due to the fact that potassium declaration on NFP is not mandatory by the food laws.

From the Table 4.3.4 and Table 4.3.5, it can be seen that the lowest analyzed potassium content was found to be in butter and cheese (0mg/100g of food) and highest in ready-to-cook foods (990 mg/100g of food). A study carried out in Rio de Janeiro, Brazil on the composition of 21 biscuits showed that the analyzed mean potassium content of the salty biscuits ranged from 154 to 275 mg/100g and sweet biscuits from 68 to 475 mg/100g (Passos et. al, 2013). The range of analyzed mean potassium content of both the salty biscuits and sweet biscuits in the present study was found to be lower than that reported for the biscuits in Brazilian study.

Comparison of potassium content of products analyzed in the present study with similar counterparts from UK database of nutrient content of processed foods revealed lower potassium content in former than the latter. The potassium content of the food products from UK versus present study are as follows, breakfast cereal and muesli without nuts and (290 to 310 mg/100g versus 100 to 300 mg/100g), low fat spreads (31 to 61 mg/100g versus 0 to 40 mg/100g), potato chips (602 to 706 mg/100g versus 360 to 960 mg/100g), chocolates (240 to 565 mg/100g versus 80 to 240 mg/100g) and instant soup (782 mg/100g of food versus 200 to 580 mg/100g) and butter (16 to 26 mg/100g versus nil) (Department of Health-UK, 2013).

The positive role of potassium in combating various NCDs namely, hypertension, cardiovascular disease, kidney stone formation and low bone-mineral density is well recognized and therefore at least 3510 mg/day potassium is recommended for a healthy adult (≥16 years) (WHO, 2012b). Lack of potassium information on NFP presents numerous challenges for patients and consumers with cardiovascular disease and also to those who are on potassium restricted diets. This lack of information also hinders adequate guidance by physicians and dietitians to the patients.

Table 4.3.6: Over-reporting, Under-reporting and Mean Sugar Content of Selected Processed Packaged Foods in Various Food categories

Food categories	No. of products	Over-reporting	Under-reporting	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	% (n)	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	14(12)	1(1)	8(7)	11±11	13±10	0.600
Noodles, pasta and macaroni	16(14)	3(3)	10(9)	3.66±3.19	5.45±1.51	1.896
Salty Biscuits	2(2)	2(2)	0	7±5.66	5.8±5.37	_
Sweet biscuits	16(14)	0	1(1)	26.57±10.25	25.66±9.5	0.243
Sweet cream wafers	1(1)	0	1(1)	24.93	32.6	_
Chocolates	11(10)	6(5)	2(2)	39.61±11.93	35.46±11.74	0.784
Cakes	1(1)	0	1(1)	23	29.8	_
Canned fruits	1(1)	0	0	21	19	_
Jam, marmalades and jellies	2(2)	0	0	74.50±14.85	75.50±10.61	_
Spreads and dips	2(2)	1(1)	0	2.05±2.90	0.8±1.13	_
Malted beverages	3(3)	0	3(3)	20.33±5.51	35.7±9.36	2.45
Soft drinks	1(1)	0	0	0	0	_
Ready to cook foods	2(2)	0	2(2)	3.85±3.46	6.6±3.82	_
Ready to eat sweets	1(1)	0	1(1)	57	74	_
Soups	7(6)	0	6(5)	13.33±10.13	18.97±13.18	0.83
Papads	1(1)	0	0	0	0	_
Ketchups and sauces	2(2)	0	2(2)	19.35±9.40	37.20±9.62	_
Namkeens and savories	6(5)	0	6(5)	4.0±1.13	7.34±1.18	4.572**
Chips	5(4)	2(2)	1(1)	7.5±2.86	5.95±1.35	0.981
Popcorn	1(1)	0	0	0	0.09	_
Cereal and milk based baby foods	2(2)	0	2(2)	9.10±2.26	17.4±2.97	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.6 shows the mean reported and analyzed sugar content of selected processed foods. Of the 87 food products that reported sugar content on the processed foods, noodles, pasta and macaroni (10%) had the highest percentage of products under-reporting the sugar content and chocolates (6%) had the highest percentage of products over-reporting the sugar content. Namkeens and savories ($p \leq 0.01$, $t=4.572$) showed significant difference between reported (4g/100g) and analyzed (7.34g/100g) sugar content. A similar study conducted in Canada examined baby and toddler food products for sugar content and found that 53% of the food products had higher sugar (>20% of calories) content than recommended values. Baby and toddler foods were not found to be nutritionally superior in terms of sugar as compared to their adult counterparts (Elliott, 2010). Analyzed sugar content was found to be higher than the reported sugar content in the food categories namely, jam, marmalades and jellies, ready-to-eat sweets, ketchups and sauces, malted beverages, sweet cream wafers, cakes, sweet biscuits, soups, cereal and milk based

baby foods, cornflakes, oats and muesli, namkeens and savories, noodles, pasta and macaroni, ready to cook foods and popcorn.

Studies have shown that over consumption of sugar sweetened beverages (SSBs) leads to weight gain, obesity and type-2 diabetes. An increased consumption of SSBs is linked with a higher risk of developing obesity in children and adults, increases the risk of developing type-2 diabetes beyond its lethal impact on body weight and a greater risk of developing cardiovascular disease (Malik et. al, 2006; Hu and Malik, 2010; Hu, 2010). Therefore, it is necessary for the consumers to keep their sugar intake within the recommended limits especially those on sugar restricted diets.

Table 4.3.7: Food Products "Not Reporting" Sugar Values in Various Food Categories

Food Categories	Not Reported % (n)	Analyzed Mean±SD (g/100g)	Analyzed Range (g/100g)
Butter and cheese	7(1)	0.0	_
Juices	7(1)	6.0	_
Ready-to-use spice mixes	21(3)	24.6±19.3	2.6-38.5
Pickles	7(1)	0.0	_
Papads	7(1)	3.1	_
Chips	7(1)	0.6	_
Namkeens and savories	50(6)	6.9±5.2	1.8-14.4

Table 4.3.7 presents data on the products that did not report sugar values on NFP. Of the total products analyzed (n=101), 14 products did not report sugar content on NFP. Majority of the products "not reporting" sugar content were namkeen and savories (50%) with sugar content as high as 14.4g/100g of food (mean=6.9±5.5 g/100g of food), followed by ready to use spice mixes (21%) with sugar content as high as 38.5g/100g of food product (in "Suhana Khoya Kaju Mix") and mean content of 24.6±19.3 g/100g of food. Therefore, "not reporting" of sugar content on NFPs may lead to high consumption of sugar by consumers or patients at risk. A similar study by Chandorkar and Shah (2014) revealed zero sugar level in juices, however in the present study juices were found to contain 6 g/100g of sugar. The differences in sugar levels in both the studies could be due to the differences in brand and type of juices analyzed.

From the Table 4.3.6 and Table 4.3.7 it can be seen that highest analyzed sugar content was found in jam, marmalades and jellies (75.5 g/100g) and nil in soft drinks, butter and cheese and pickles. Though jam, marmalades and jellies were found to

contain high sugar levels, yet they may not contribute significantly in daily total sugar intake as their serving size is smaller.A study conducted in UK found a lower analyzed sugar content in low fat spreads (0 to 0.5g/100g of food), chips (0.4 to 1 g/100g of food) and instant soups (17.4 g/100g of food) compared to the analyzed sugar content in the similar foods from the present study. It was also found that the breakfast cereal without nuts (25.3g/100g of food), muesli type cereal with nuts (23.1 g/100g of food), chocolates (45.4 to 69 g/100g of food), mayonnaise (2.4g/100g of food) and butter (0.5 to 0.8g/100g of food) from UK were high in analyzed sugar content as compared to their counterparts from the present study (Department of Health-UK, 2013).

As compared to the present study, an investigation by Chandorkar and Shah (2014) revealed lower analyzed sugar content in food products namely, noodles and pasta (4.95 g/100g), namkeens and savories (3.4 g/100g), soups (3.2 g/100g) and higher sugar content in sweet biscuits (30g/100g), soft drinks (12.4 g/100g) and salted biscuits (9.8 g/100g). A large difference in the sugar content in soft drinks from the present study and study by Chandorkar and Shah (2012) is due to the product differences. In the present study the analyzed soft drink was “Diet Coke” and therefore, no sugar content was found in the same. A meta-analysis by Johnson and Bethany (2010) showed a strong relationship between higher intakes of soft drink with greater energy intake, higher body weight, lower intake of other nutrients and worse health indices.

Table 4.3.8: Over-reporting, Under-reporting and Mean Fiber Content of Selected Processed Packaged Foods in Various Food Categories

Food categories	No. of products	Over-reporting	Under-reporting	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	% (n)	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	30(12)	0	30(12)	6.033±2.64	15.5±3.66	7.270***
Noodles, pasta and macaroni	20(8)	0	20(8)	3.36±1.37	11.5±3.16	6.686***
Sweet Biscuit	10(4)	0	10(4)	6.85±3.65	13.0±4.90	2.014
Chocolates	5(2)	3(1)	3(1)	7.4±9.76	6.5±4.95	_
Canned fruits	3(1)	0	3(1)	0.9	3	_
Jam, marmalades and jellies	5(2)	0	5(2)	0.5±0.71	3.0±0.0	_
Ready to cook foods	3(1)	0	3(1)	1	50	_
Soups	5(2)	0	5(2)	2.6±0.71	10.5±6.36	_
Papads	3(1)	0	3(1)	10	23	_
Namkeens and savories	10(4)	0	10(4)	3.25±2.5	9.75±4.79	2.407*
Popcorn	3(1)	0	3(1)	8	27	_
Cereal and milk based baby foods	5(2)	0	5(2)	1.25±0.35	7.5±0.71	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.8 show that of the 101 products analyzed, 39.6% (n=40) of the products reported fiber content on NFP. A similar study by Chandorkar and Shah (2014) showed that only 7% of the packaged food products reported fiber content. From the present study it was found that analyzed fiber values were higher than the reported values in all the food categories except for the chocolates. Of the 40 food products that reported fiber values, under-reporting the fiber content was observed in cornflakes, oats and muesli (30%), followed noodles, pasta and macaroni (20%), sweet biscuits (10%), namkeens and savories (10%), jam, marmalades and jellies (5%), soups (5%), cereal and milk based baby foods (5%) and the remaining food categories had less than 5% of the products that under-reported the fiber values. Food categories namely, cornflakes, oats and muesli ($p \leq 0.001$, $t=7.270$), noodles, pasta and macaroni ($p<0.001$, $t=6.686$) and namkeen and savories ($p<0.05$, $t=2.407$) showed a significant difference between reported and analyzed values of fiber. Due to the paucity of data on dietary fiber content of processed foods, the results cannot be discussed further.

Table 4.3.9: Food Products "Not Reporting" Dietary Fiber Values in Various Food Categories

Food Categories	Not Reported % (n)	Analyzed Mean (g/100g)	Analyzed Range (g/100g)
Noodles, pasta and macaroni	10(6)	9.8±2.3	6 -12
Salty biscuits	3(2)	12.5±2.1	11-14
Sweet biscuits	16(10)	9.8±3.2	6-16
Sweet cream wafers	2(1)	9.0	_
Cakes	2(1)	11.0	_
Chocolates	13(8)	10.8±2.8	6 -14
Butter and cheese	2(1)	0.0	_
Spreads and dips	3(2)	0.0	_
Soft drinks	2(1)	0.0	_
Malted beverages	5(3)	14.7±4.0	11-19
Juices	2(1)	0.0	_
Ready to cook foods	2(1)	16.0	_
Ready to eat sweets	2(1)	4.0	_
Soups	7(4)	10.8±6.2	4-19
Ready-to-use spice mixes	5(3)	26.0±13.0	18-41
Ketchups and sauces	3(2)	6.0±0.0	6
Pickles	3(2)	8.0±4.2	5 - 11
Chips	8(5)	11.8±4.2	9-12
Namkeens and savories	12(7)	22.1±9.6	13-35

Table 4.3.9 reveal that the fibre content was not reported in 60.4% (n=61) of the products analyzed. Of the 61 products that did not report fiber values, 16.4% of the sweet biscuits did not report the same, followed by chocolates (13%), namkeen and savories (12%), noodles, pasta and macaroni (10%), chips (8%), soups (7%), malted beverages (5%), ready-to-use spice mixes (5%) and the remaining food categories had less than 5% of the products that did not report fiber content on NFP. The fiber content in these food products ranged from 4 to 41 g/100g. The importance of fiber intake is largely due to its beneficial health effects (Tosh and Yada, 2010; Menezes et. al, 2009; Lee et. al, 2008b). Diets low in dietary fiber underlie or exacerbate constipation, appendicitis, hemorrhoids, deep vein thrombosis, varicose veins, diverticulitis, hiatal hernia, and gastro esophageal reflux (Cordain et. al, 2005).

Table 4.3.8 and Table 4.3.9 indicate that the highest analyzed dietary fiber content was in ready-to-use spice mixes (26.0 g/100g) and nil in butter and cheese, spreads and dips, soft drinks and juices.

In addition to the total fiber content of a food product, it is important to know its water solubility since the physiological effects of soluble and insoluble fiber are different. The reduction of blood cholesterol and sugar levels are related to the consumption of soluble fiber while insoluble fibers can reduce the risk of developing diabetes mellitus and have beneficial effects on intestinal health (Theuwissen and Mensink, 2008; Isken et al, 2010; Hsu et al, 2009). Though information on fiber content is of great importance, yet majority of the food labels did not report the same. This is due to the fact that Indian Food Laws do not mandate labeling of fiber on NFP. Therefore, efforts should be made for bringing laws for mandatory reporting of fiber and its fractions namely, soluble and insoluble fiber.

Table 4.3.10: Over-reporting, Under-reporting and Mean Total Fat Content of Selected Processed Packaged Foods in Various Food Categories

Food categories	No. of products	Over-reporting	Under-reporting	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	% (n)	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	12(12)	12(12)	0	4.86±3.0	1.77±1.52	3.211**
Noodles, pasta and macaroni	14(14)	13(13)	0	11.85±6.44	7.18±4.26	2.263*
Salty Biscuits	2(2)	2(2)	0	15.1±1.56	8.22±1.88	_
Sweet biscuits	14(14)	14(14)	0	16.85±5.01	9.18±3.12	4.854***
Sweet cream wafers	1(1)	1(1)	0	15.6	9.1	_
Chocolates	10(10)	10(10)	0	18.94±5.15	10.97±5.2	3.436**
Cakes	1(1)	1(1)	0	18	5.9	_
Canned fruits	1(1)	0	0	0.1	0	_
Jam, marmalades and jellies	2(2)	0	0	0	0	_
Butter and cheese	1(1)	1(1)	0	70	59.9	_
Spreads and dips	2(2)	2(2)	0	50.45±12.09	20.26±28.27	_
Malted beverages	3(3)	3(3)	0	5±5.20	2.0±3.0	0.864
Soft drinks	1(1)	0	0	0	0	_
Juices	1(1)	0	0	0	0	_
Ready to cook foods	2(2)	2(2)	0	6.8±1.13	4.29±1.02	_
Ready-to-use spice mixes	3(3)	3(3)	0	11.33±2.52	6.17±0.64	3.419*
Ready to eat sweets	1(1)	1(1)	0	1.6	0.8	_
Soups	6(6)	6(6)	0	6.95±6.18	2.70±1.8	1.62
Pickles	1(1)	0	0	9	8.4	_
Ketchups and sauces	2(2)	0	0	0	0	_
Namkeens and savories	11(11)	11(11)	0	29.51±10.71	14.51±6.36	3.991***
Chips	5(5)	5(5)	0	25.18±8.96	9.14±6.19	3.291**
Popcorn	1(1)	1(1)	0	28	12.6	_
Cereal and milk based baby foods	2(2)	2(2)	0	9±0	1.08±0.47	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.10 show that of the 101 products analyzed, 98% (n=99) of the products reported total fat content and 2% (n=2) of the products did not report the same on NFP. Of the 99 products that reported fat values on NFP, 90% of the products over-reported the fat content while under-reporting was not observed in any of the products. The remaining food products had similar or less than 10% variation in reported and analyzed values for fat. Majority of the products reported higher fat values than the analyzed fat content. Canned fruits, jam, marmalades and jellies, soft drinks, juices and ketchups and sauces had no fat sources in the ingredients list and therefore, the reported and analyzed values were zero. Food categories namely, cornflakes, oats and muesli ($p \leq 0.01$, $t=3.211$), noodles, pasta and macaroni ($p \leq 0.05$, $t=2.263$), sweet biscuits ($p \leq 0.001$, $t=4.854$), chocolates ($p \leq 0.01$, $t=3.436$), ready-to-

use spice mixes ($p \leq 0.05$, $t=0.027$), namkeens and savories ($p \leq 0.001$, $t=3.991$) and chips ($p \leq 0.01$, $t=3.291$) showed a significant difference between reported and analyzed values for total fat. Total fat content was found to be highest in butter and cheese (reported=70 g/100g and analyzed=59.9 g/100g). A similar study conducted in Malaysia also showed that the analyzed fat values (range 9.4% to 15.0%) of semi-sweet biscuits were lower than the reported values (range 9.9% to 16.8 %) (Mamat, 2012). In the present study the NFP of fried and baked chips was also examined. The fried chips reported a higher fat content (31.7 g/100g) than the baked chips (15.4 g/100g) however a negligible difference of 0.37 g/100g was observed between analyzed fat content of fried and baked chips varieties. This observation reveals that, though the baked chips are marketed as low in fat but still may contain high fat.

Study by Chandorkar and Joshi (2012) and Johnson et. al. (2012) showed a higher fat content in noodles and pasta as compared to the present study. Fat content in noodles and pasta reported by Chandorkar and Joshi (2012) was 13.85 to 18.69 g/100g and by Johnson et. al (2012), 14.1g/100g. Analyzed total fat content of chips (9.14 g/100g) and namkeens and savories (14.51 g/100g) in the present study was lower than that analyzed by Johnson et. al. (2012) wherein chips had 33 g/100g of fat and namkeens and savories had 35.9 g/100g of fat.

The products from the present study was found to contain lower analyzed total fat content as compared to the similar investigations from Hongkong and UK. Total fat content of the food products from Hongkong is as follows, instant soup (4.9g/100g), sweet biscuits (20g/100g), instant noodles (20 g/100g), chips (23 g/100g), cream biscuits (29 g/100g), chocolates (32 g/100g) and spread (46 g/100g) (Chung et. al, 2013). Analyzed total fat content of the products in the present study versus UK study is as follows, potato chips (9.14 g/100g versus 3.2 to 3.4 g/100g of food), breakfast cereal and muesli type cereals without nuts (1.77 g/100g versus 11.6 to 20.5 g/100g of food), instant soup (2.70 g/100g versus 13.4 g/100g of food), chocolates (10.97 g/100g versus 15.3 to 28.2 g/100g of food), low fat spreads (20.26 g/100g versus 36.9 to 39.0g/100g of food) and butter (59.9 g/100g versus 60.2 to 79.1 g/100g of food) (Department of Health-UK, 2013).

Similarly, a study conducted in Rio de Janeiro, Brazil on the composition of 21 biscuits showed that the analyzed mean total fat content of the salty biscuits (ranged

17.3 to 23.2g/100g) and sweet biscuits (12 to 29 g/100g) were higher than the present study. However, the reported total fat content in Brazilian biscuits (salty biscuits=10 to 21g/100g and sweet biscuits= 2 to 28 g/100g) were lower than the biscuits studied in the present study (Passos et. al, 2013).

A study conducted in Delhi, India on total fat content of commonly consumed snacks among the population revealed that the total fat content was highest in mathari (48.8 g/100g of food) followed by balushahi (48.5 g/100g of food), laddu (31 g/100g of food), bhatura (31g/100g of food), bread pakora (25 g/100g of food), cake (20 g/100g of food), samosa (19.4 g/100g of food), biscuit 918 g/ 100g of food) and bread (1.8 g/100g of food) (Karn et. al, 2013).

An investigation carried out in Vancouver, Canada on 200 foods purchased from retail stores and restaurants revealed that total fat content was highest in peanut butter (43.5 g/100g of food) followed by potato chips (25.1g/100g of food), chocolate bars (23.6 g/100g), pie shells (18.3 g/100g of food), cookies (16.7 g/100g of food), meat patty (16.4 g/100g of food), croissants (16.3 g/100g of food), croutons (15.7 g/100g), crackers (15.3 g/100g), breaded chicken (13.4g/100g) donut (13g/100g), granola bars (11.5g/100g), muffins (9.4g/100g), sauces and gravy (8.7g/100g), soups (8.3g/100g), cake mixes (7.6g/100g), french fries (5.8g/100g), breakfast cereals (3 g/100g), whole wheat bread (2.7g/100g) and white bread (2.2g/100g). A study involving 150 products from 12 Irish fast food outlets revealed that total fat content of the products ranged from 12.1 g to 29.2g/100g of food. Product-wise total fat content was 25.3 g/10g in hash brown, 24.6 g/100g in onion rings, 22.7 to 29.2 g/100g in suasages, 21.6 g/100g in breaded chicken, 20.6 g/100g in chicken burger, 17.5 g/100g in beef burger, 15.6g/100g in breakfast sandwich and 12.1 to 19.1 g/100g in garlic bread (FSAI, 2008). Therefore, food products in the present study were lower in total fat content as compared to several other studies discussed above.

Products in the present study that did not report total fat content on NFP were pickle and papad, however when analyzed it was found that pickle contained 7.1g/100g and papad had 0.2 g/100g of total fat in per 100 g of food.

Table 4.3.11: Mean SFA Content of Selected Processed Packaged Foods in Various Food Categories

Food categories	No. of Products	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	17(7)	0.44±0.23	0.13±0.10	3.256
Noodles, pasta and macaroni	7(3)	5.2±4.56	2.27±2.47	0.99
Salty Biscuits	2(1)	7	4.1	_
Sweet biscuits	14(6)	8.33±2.44	5.48±5.15	1.226
Chocolates	5(2)	14.85±10.11	0.87±0.07	_
Cakes	2(1)	10	0.6	_
Butter and cheese	2(1)	37	31.5	_
Spreads and dips	2(1)	30	25.1	_
Malted beverages	2(1)	1.2	0.2	_
Ready to cook foods	5(2)	2.35±0.50	0.29±0.104	_
Ready to eat sweets	2(1)	0.4	0.3	_
Soups	5(2)	0.19±0.13	0.23±0.26	_
Namkeens and savories	24(10)	12.76±4.48	9.98±10.18	1.922
Chips	7(3)	14.09±0.59	1.87±2.0	10.275***
Popcorn	2(1)	14	0.1	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.11 show the mean reported and analyzed saturated fatty acid values. Saturated fatty acid values were declared in 42 food products, of which top 5 food categories that reported SFA content were namkeens and savories (24%), cornflakes, oats and muesli (17%), sweet biscuits (14%), chips (7%) and noodles, pasta and macaroni (7%). Of the products that reported SFA values, majority of the products had lower analyzed SFA values than the reported values except for soups wherein the reported values were 0.19 g/100g and analyzed values were 0.23 g/100g. From the table it can be inferred that butter and cheese had the highest reported and analyzed SFA content of 37 g/100g and 31.5 g/100g, respectively. The student t-test revealed a statistically significant difference between the mean reported and analyzed values of SFA in chips ($p \leq 0.001$, $t=10.275$). No significant difference between the reported and analyzed SFA content was observed in the remaining food categories.

Table 4.3.12: Food Products "Not Reporting" SFA Values in Various Food Categories

Food Categories	Not Reported % (n)	Analyzed Mean (g/100g)	Analyzed Range (g/100g)
Cornflakes,oats and muesli	8 (5)	0.93±0.61	0.4 to 1.7
Noodles, pasta and macaroni	19 (11)	2.89±3.20	0.2 to 9.2
Salty Biscuits	2 (1)	4.80	_
Sweet Cream Wafers	15 (9)	2.17±2.31	0.2 to 6.6
Chocolates	14 (8)	5.73±5.22	0.7 to 16.1
Canned Fruits	2 (1)	0.00	_
Jam, marmalades and jellies	3 (2)	0.00	_
Spreads and dips	2 (1)	0.00	_
Soft Drinks	2 (1)	0.00	_
Malted beverages	3 (2)	1.67±2.10	0.2 to 3.2
Juices	2 (1)	0.00	_
Soups	7 (4)	1.28±0.74	0.2 to 2.0
Ready-to-use spice mixes	5 (3)	2.46±1.67	0.5 to 3.7
Ketchups and sauces	3 (2)	0.00	_
Pickles	3 (2)	2.81±2.97	0.7 to 4.9
Papads	2 (1)	0.10	_
Chips	3 (2)	3.83±2.90	1.8 to 5.9
Namkeens and savories	2 (1)	2.70	_
Cereal and milk based baby foods	3 (2)	0.26±0.17	0.1 to 0.4

Table 4.3.12 reveal that the SFA content was not reported in 58.4% (n=59) of the products analyzed. Nineteen percent of the food products not reporting SFA content were from noodles, pasta and macaroni (range 0.2 to 9.2 g/100g of food), followed by sweet cream wafers (15%, range 0.2 to 6.6 g/100g of food), chocolates (14%, range 0.7 to 16.1 g/100g of food), cornflakes, oats and muesli (8%, range 0.4 to 1.7 g/100g of food), soups (7%, range 0.2 to 2.0 g/100g of food), ready to use spice mixes (5%, range 0.5 to 3.7 g/100g of food) and the remaining food categories had less than 5% of the products which did not report SFA content on NFP.

Of the 59 food products that did not report SFA values, 43 products contained substantial amount of analyzed SFA content and they were chocolates (5.73 g/100g), salty biscuits (4.80 g/100g), chips (3.83 g/100g), noodles, pasta and macaroni (2.89 g/100g), pickles (2.81 g/100g), sweet cream wafers (2.17 g/100g), namkeens and savories (2.70 g/100g), ready-to-use spice mixes (2.46 g/100g), malted beverages

(1.67 g/100g) and soups (1.28 g/100g). SFA content was found to be nil in those food categories that does not contain fat as an ingredient. Such foods were canned fruits, jam, marmalades and jellies, soft drinks, juices and ketchups and sauces. Spreads and dips were also found to have no SFA content as they contained edible or refined vegetable oils as the sources of fat in ingredients list which are non SFA sources of fat. Food categories namely, cornflakes, oats and muesli, papads and cereal and milk based baby foods had negligible analyzed SFA content.

Table 4.3.11 and Table 4.3.12 reveal that analyzed SFA content was highest in butter and cheese (31.5 g/100g of food). A study conducted on 150 products from 12 Irish fast food outlets revealed that 4.6% (7/150) of the products were high in SFA content. The SFA content in the products is as follows, onion rings- 13.3 g/100g, cheese cake- 12.9 g/100g, sausages- 7.6 to 12 g/100g, quarter pounder- 5.3 to 7.3 g/100g, breakfast roll- 7.2 g/100g, meat pizza- 5.3 to 6.8 g/100g and chicken wrap- 4.7g/100g (FSAI, 2008). SFA content of the products in the present study were found to be lower than their counterparts from other countries. A study from Hongkong on 142 food products revealed that cream biscuits (14 g/100g) had the highest analyzed SFA content followed by chocolates (13 g/100g), sweet biscuits (9.1g/100g), spread (9.1 g/100g), instant noodles (8.6 g/100g), chips (5.2 g/100g) and instant soup (2.2 g/100g) (Chung et. al, 2013). Similarly, SFA content in majority of the products in the present study was found to be lower than the products analyzed in the study from UK. Highest SFA content in products from UK was found in margarine (26.41 g/100g of food) followed by butter (25.10 to 34.15 g/100g of food), instant soup (8.70 g/100g of food), low fat spreads (8.55 to 9.76g/100g of food), mayonnaise (5.65 g/100g of food), muesli type cereal with nuts (4.61 g/100g of food) breakfast cereal without nuts (4.15 g/100g of food), chocolates (3.57 to 18.71 g/100g of food) and potato chips (0.78 to 1.30 g/100g of food) (Department of Health-UK, 2013). Therefore, there is wide variability in the SFA content of processed foods from various countries.

Table 4.3.13: Mean MUFA Content of Selected Processed Packaged Foods in Various Food Categories

Food categories	No. of products	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	19(7)	1.39±1.56	0.45±0.48	1.507
Noodles, pasta and macaroni	5(2)	6.45±1.34	2.12±2.10	
Salty Biscuits	3(1)	5	2.6	
Sweet biscuits	16(6)	6.5±1.79	2.47±1.96	3.738**
Cakes	3(1)	4	5.1	
Butter and cheese	3(1)	26	2.4	
Spreads and dips	3(1)	22	12.2	
Malted beverages	3(1)	0.4	0	
Ready to cook foods	5(2)	2.25±0.35	3.09±2.31	
Ready to eat sweets	3(1)	1.1	0.7	
Namkeens and savories	27(10)	12.798±4.73	5.87±7.73	2.414*
Chips	8(3)	13.59±1.02	3.36±3.73	4.563**
Popcorn	3(1)	10	0.2	

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.13 show the mean reported and analyzed mono-unsaturated fatty acid (MUFA) values. MUFA was reported in 37 food products of which majority were namkeens and savories (27%), followed by cornflakes, oats and muesli (19%), sweet biscuits (16%), chips (8%), noodles, pasta and macaroni (5%), ready-to-cook foods (5%) and the remaining food categories had less than 5% of the products that reported MUFA values. Cakes and ready-to-cook foods had higher analyzed MUFA values than the reported values. Reported MUFA values was highest in chips (13.59 g/100g) and lowest in malted beverages (0.4 g/100g). A statistically significant difference between reported and analyzed MUFA values was observed in sweet biscuits ($p \leq 0.01$, $t=3.738$), namkeens and savories ($p \leq 0.05$, $t=2.414$) and chips ($p \leq 0.01$, $t=4.563$). No significant difference was observed between reported and analyzed MUFA content in the remaining food categories.

Table 4.3.14: Food Products "Not Reporting" MUFA Values in Various Food Categories

Food Categories	Not Reported % (n)	Analyzed Mean (g/100g of food)	Analyzed Range (g/100g of food)
Cornflakes,oats and muesli	8 (5)	0.8±0.5	0.1 to 1.4
Noodles, pasta and macaroni	19 (12)	2.3±2.6	0.6 to 9.0
Salty Biscuits	2 (1)	4.7	_
Sweet Cream Wafers	14 (9)	3.9±1.4	2.1 to 6.3
Chocolates	16 (10)	1.8±1.1	0.3 to 4.3
Canned Fruits	2 (1)	0	_
Jam, marmalades and jellies	3 (2)	0	_
Spreads and dips	2 (1)	0.1	_
Soft Drinks	2 (1)	0	_
Malted beverages	3 (2)	0.3±0.4	0.0 to 0.6
Juices	2 (1)	0	_
Soups	9 (6)	1.4±1.2	0.4 to 3.1
Ready-to-use spice mixes	5 (3)	2.6±0.4	2.2 to 3.0
Ketchups and sauces	3 (2)	0	_
Pickles	3 (2)	3.4±0.2	3.3 to 3.5
Papads	2 (1)	0	_
Chips	3 (2)	2.4±2.5	0.6 to 4.2
Namkeens and savories	2 (1)	0.3	_
Cereal and milk based baby foods	3 (2)	0.3±0.0	_

Table 4.3.14 reveal that MUFA was not reported in 63.4% (n=64) of the products analyzed. Noodles, pasta and macaroni had the highest percentage (19%) of the products not reporting MUFA values (range 0.6 to 9.0 g/100g of food), followed by chocolates (16%, range 0.3 to 4.3 g/100g of food), sweet cream wafers (14%, range 2.1 to 6.3 g/100g of food), soups (9%, range 0.4 to 3.1 g/100g of food), cornflakes, oats and muesli (8%, range 0.1 to 1.4 g/100g of food), ready to use spice mixes (5%, range 2.2 to 3.0) and the remaining food categories had less than 5% of the products that did not report MUFA content on NFP. Of the food products that did not report MUFA values on NFP, cornflakes, oats and muesli, namkeens and savories, malted beverages and spreads and dips had negligible MUFA content while salty biscuits (4.7 g/100g), sweet cream wafers (3.9 g/100g), pickles (3.4 g/100g), ready-to-use spice mixes (2.6 g/100g), chips (2.4 g/100g), noodles, pasta and macaroni (2.3 g/100g), chocolates (1.8 g/100g) and soups (1.4 g/100g) had substantial MUFA levels.

From the Table 4.3.13 and 4.3.14 it can be seen that analyzed MUFA values was highest in spreads and dips (12.2 g/100g) and the same was nil in those food categories that did not had sources of fat in ingredients list. The food categories were canned fruits, jam, marmalades and jellies, soft drinks, juices, ketchups and sauces and papads. Analyzed MUFA levels of the products in the present study versus UK study were lower for instant soup (1.4 g/100g versus 3.08 g/100g) and breakfast cereal and muesli without nuts (0.8 g/100g versus 4.46 to 10.62 g/100g) while the same was higher in low fat spreads (12.2 g/100g versus 11.45 to 21.54g/100g), potato chips (2.4 g/100g versus 1.36 to 1.84 g/100g) and chocolates (1.8 g/100g versus 1.72 to 15.58 g/100g of food) (Department of Health-UK, 2013). Reporting of MUFA was not common in the studied products and but they were found to contain substantial MUFA content.

Table 4.3.15: Mean PUFA Content of Selected Processed Packaged Foods in Various Food Categories

Food categories	No. of products	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	19(7)	1.014±0.63	0.33±0.48	2.231*
Noodles, pasta and macaroni	5(2)	2.15±0.212	0.052±0.02	_
Salty Biscuits	3(1)	1	0.1	_
Sweet biscuits	16(6)	1.58±0.60	0.40±0.83	2.818*
Cakes	3(1)	0.7	0	_
Butter and cheese	3(1)	7	0.2	_
Spreads and dips	3(1)	6	0.2	_
Malted beverages	3(1)	0.3	0.1	_
Ready to cook foods	5(2)	1.9±0.14	0.9±1.20	_
Ready to eat sweets	3(1)	0.3	0.3	_
Namkeens and savories	27(10)	4.10±1.95	0.69±1.12	4.786***
Chips	8(3)	3.55±0.27	3.14±3.92	0.186
Popcorn	3(1)	4	0.1	_

****significant at 0.001 level, ***significant at 0.01 level, *significant at 0.05 level*

Table 4.3.15 show the mean reported and analyzed polyunsaturated fatty acid (PUFA) values. PUFA was declared in 37 food products of which majority of products were namkeens and savories (27%), cornflakes, oats and muesli (19%), sweet biscuits (16%), chips (8%), noodles, pasta and macaroni (5%), ready-to-cook foods (5%) and the remaining food categories had less than 5% of the products that reported PUFA content on NFP. Analyzed PUFA values in all the food categories were lower than the reported values. Reported PUFA values was highest in butter and cheese (7 g/100g) and lowest in each malted beverages and ready to eat sweets (0.3 g/100g). A statistically significant difference between reported and analyzed

PUFA content was observed in cornflakes, oats and muesli (p≤0.05, t=2.231), sweet biscuits (p≤0.05, t=2.818) and namkeen and savories (p≤0.001, t=4.786).

Table 4.3.16: Food Products "Not Reporting" PUFA Values in Various Food Categories

Food Categories	Not Reported % (n)	Analyzed Mean (g/100g of food)	Analyzed Range (g/100g of food)
Cornflakes,oats and muesli	8(5)	0.7±0.8	0.0 to 1.9
Noodles, pasta and macaroni	19(12)	0.1±0.2	0.0 to 0.7
Salty Biscuits	2(1)	0	_
Sweet Cream Wafers	14(9)	1.4±1.4	0.0 to 3.7
Chocolates	16(10)	3.9±4.1	0.0 to 11.0
Canned Fruits	2(1)	0	_
Jam, marmalades and jellies	3(2)	0	_
Spreads and dips	2(1)	0.1	_
Soft Drinks	2(1)	0	_
Malted beverages	3(2)	0.3±0.2	0.1 to 0.4
Juices	2(1)	0	_
Soups	9(6)	0.2±0.3	0.0 to 0.7
Ready-to-use spice mixes	5(3)	0.1±0.1	0.0 to 0.2
Ketchups and sauces	3(2)	0	_
Pickles	3(2)	1.5±1.9	0.1 to 2.8
Papads	2(1)	0.1	_
Chips	3(2)	0.2±0.3	0.0 to 0.4
Namkeens and savories	2(1)	1.8	_
Cereal and milk based baby foods	3(2)	0.1±0.1	0.1 to 0.2

Table 4.3.16 reveal that the PUFA content was not reported in 63.4% (n=64) of the products analyzed. Noodles, pasta and macaroni had the highest percentage (19%) of products not reporting PUFA values (range 0.0 to 0.7 g/100g of food) followed by chocolates (16%, range 0.0 to 11.0 g/100g of food), sweet cream wafers (14%, range 0.0 to 3.7 g/100g of food), soups (9%, range 0.0 to 0.7 g/100g of food), cornflakes, oats and muesli (8%, range 0.0 to 1.9 g/100g of food), ready-to-use spice mixes (5%, range 0.0 to 0.2) and the remaining food categories had less than 5% of the products that did not report PUFA content on NFP.

Of those products that did not report PUFA values, analyzed values showed negligible amount of PUFA in cornflakes, oats and muesli, noodles, pasta and macaroni, spreads and dips, malted beverages, soups, ready-to-use spice mixes, papads, chips and cereal and milk based baby foods. Substantial amount of PUFA was found in sweet cream wafers (1.4 g/100g), chocolates (3.9 g/100g), pickles (1.5 g/100g) and namkeens and savories (1.8 g/100g).

Table 4.3.15 and 4.3.16 indicate that analyzed PUFA values was highest in chocolates (3.9 g/100g)and nil in cakes, canned fruits, jam, marmalades and jellies,

soft drinks, juices and ketchup and sauces. PUFA levels of the products in the present study versus UK study were lower for breakfast cereal and muesli without nuts (0.33g to 0.70 g/100g versus 2.33 to 4.22 g/100g), low fat spreads (0.1 to 0.2 g/100g versus 6.36 to 14.96g/100g), potato chips (0.2 to 3.14 g/100g versus 2.45 to 2.80 g/100g), instant soup (0.2 g/100g versus 1.00 g/100g) and butter (0.2 g/100g versus 7.75 to 10.0 g/100g) and the same was higher for chocolates (3.9 g/100g versus 0.39 to 2.08 g/100g) (Department of Health-UK, 2013).

Table 4.3.17: Mean TFA Content of Selected Processed Packaged Foods in Various Food Categories

Food categories	No. of products	Reported (g/100g)	Analyzed (g/100g)	t-value
	% (n)	Mean±SD	Mean±SD	
Cornflakes, oats and muesli	16(7)	0	0.124±0.284	1.140
Noodles, pasta and macaroni	7(3)	0	0.046±0.041	1.000
Salty Biscuits	2(1)	0	0	_
Sweet biscuits	14(6)	0.333±0.817	0.802±1.232	0.770
Cakes	2(1)	2.7	0.2	_
Canned fruits	2(1)	0	0	_
Jam, marmalades and jellies	2(1)	0	0	_
Butter and Cheese	2(1)	0	17.2	_
Spreads and dips	5(2)	0	1.40±1.980	_
Malted beverages	2(1)	0	0	_
Ready to cook foods	5(2)	0.300±0.424	0.021±0.030	_
Ready to eat sweets	2(1)	0	0.1	_
Soups	5(2)	0	0.004±0.005	_
Papads	2(1)	0	0	_
Namkeens and savories	23(10)	0	0.203±0.578	1.122
Chips	7(3)	0	0.137±0.199	1.000
Popcorn	2(1)	0	0	_

****significant at 0.001 level, **significant at 0.01 level, *significant at 0.05 level*

Table 4.3.17 show the mean reported and analyzed TFA values. Of the 44 products that reported TFA content on NFP, majority were namkeens and savories (23%) followed by cornflakes, oats and muesli (16%), sweet biscuits (14%), noodles, pasta and macaroni (7%), chips (7%), spreads and dips (5%), ready to cook foods (5%), soups (5%) and the remaining food categories had less than 5% of the products that reported TFA content. Reported TFA content ranged from 0 to 2.7 g/100g. However, when analyzed it ranged from 0 to 17.2 g/100g. No significant difference between reported and analyzed TFA values was observed in any of the food categories.

Table 4.3.18: Food Products "Not Reporting" TFA Values in various Food Categories

Food Categories	Not Reported % (n)	Analyzed Mean (g/100g of food)	Analyzed Range (g/100g of food)
Cornflakes, oats and muesli	9 (5)	0.01±0.03	0.00 to 0.06
Noodles, pasta and macaroni	19(11)	0.13±0.33	0.00 to 1.11
Salty Biscuits	2(1)	0.00	_
Sweet Cream Wafers	16(9)	0.00	_
Chocolates	18(10)	0.37±1.17	0.00 to 3.71
Jam, marmalades and jellies	2(1)	0.00	_
Soft Drinks	2(1)	0.00	_
Malted beverages	4(2)	0.00	_
Juices	2(1)	0.00	_
Soups	7(4)	0.23±0.23	0.00 to 0.54
Ready-to-use spice mixes	5(3)	0.00	_
Ketchups and sauces	4(2)	0.00	_
Pickles	4(2)	0.00	_
Chips	4(2)	0.12±0.17	0.00 to 0.24
Namkeens and savories	2(1)	0.00	_
Cereal and milk based baby foods	4(2)	0.04±0.05	0.00 to 0.07

Table 4.3.18 reveal that the TFA was not reported in 56.4% (n=57) of the products analyzed. Noodles, pasta and macaroni had the highest percentage (19%) of the products not reporting TFA values followed by chocolates (18%), sweet cream wafers (16%), cornflakes, oats and muesli (9%), soups (7%), ready-to-use spice mixes (5%) and the remaining food categories had less than 5% of the products that did not report TFA content on NFP. Though not reporting of TFA was common in the studied products, yet they were found to contain substantial amount of TFA when analyzed. Similar study carried out in China revealed that 80% of the western style food and 33% of the Chinese style food contained 5% TFA of the total fat content, yet none of the 97 analyzed products reported TFA content on NFP (Fu et. al, 2008).

Table 4.3.17 and Table 4.3.18 indicate that analyzed TFA content was highest in butter and cheese (17.2 g/100g) and nil in salty biscuits, canned fruits, jam, marmalades and jellies, malted beverages, papads, popcorn, sweet cream wafers, soft drinks, juices, ready-to-use spice mixes, ketchups and sauces and pickles. Johnson et. al, (2012) carried out a study on TFA content of Indian snacks and found that maximum amount of trans fats were present in fries (1.6 g/100 g), instant noodles (0.6 g/100 g), Indian local snacks (1.6 g/100 g), burgers (0.4 g/100 g

sample), fried chicken (0.7 g/100 g), potato chips (1.5 g/100g) and pizzas (0.1 g/100 g). However, in the present study TFA content in noodles and chips were lower than that found by Johnson. A study carried out in Vancouver, Canada to determine the fatty acid content of 200 foods revealed highest TFA content in hard margarine (39.8g/100g) followed by soft margarine (16.8g/100g), crackers (6.4g/100g of food), croutons (6.3g/100g), donut (3.9g/100g), pie shells (3.8 g/100g), breaded chicken (3.7 g/100g), sauces and gravy (3.6g/100g), cookies (3.5g/100g), croissants (3.0 g/100g), soups (2.6 g/100g), cake mixes and chocolate bars (2.3 g/100g each), french fries (2.1g/100g), peanut butter (1.9 g/100g), potato chips (1.4 g/100g), muffins (1.3g/100g), meat patty (1.1 g/100g), granola bars (0.9 g/10g), whole wheat bread (0.5 g/100g), white bread (0.4 g/100g) and breakfast cereals (0.1 g/100g). The results showed that the amount of trans fatty acids varied considerably among foods within a category, reflecting differences in the fats and oils used in the manufacturing or during preparation. For example, the range of trans fatty acids in 17 brands of crackers was 23 to 51% of total fatty acids, represented a difference of 1 to 13 g trans fatty acids per 100 g cracker. The results also showed that the trans fatty acid intake ranged from as low as 1.4 g/day to 25.4 g/day (Innis et. al, 1999). Similarly, Ghafoorunissa (2008), highlighted that the vanaspati (PHVO) used in Indian cooking and in the preparation of commercially fried, processed, bakery, ready-to-eat and street foods contain up to 40% TFA. TFA content in Indian sweets and biscuits ranged from 6-26% and 30-40%, respectively. Analyzed TFA values of the processed foods in the present study were higher (range 0 to 17.2 g/100g) as compared to the products reported in Bangkok study (range 0 to 5.27 g/100g). An investigation carried out in Bangkok on 24 samples of bakery products and 6 samples of partially hydrogenated vegetable oils revealed that the highest TFA content was in shortening (1.84 to 3.37 g/100g of food) followed by butter cookie (0.25 to 5.27g/100g), margarine (1.54 to 1.89g/100g), rich butter bun (0.21 to 0.88g/100g), crispy pie (0.41 to 0.58 g/100g), brownie (0.18 to 0.67 g/100g), croissant (0.14 to 0.83 g/100g), cake cream roll (0.16 to 0.73 g/100g), cracker (Not Detectable to 0.15 g/100g) and sandwich chocolate cookie (Not Detectable to 0.14 g/100g). The mean TFA value in all selected foods ranged from 0.14 to 2.43 g/100g while the highest amount of TFA was found in butter cookie (5.07 g/100 g) (Narkwichian et. al, 2009).A study in Spain on bakery products found no significant amounts of TFA in any of the analyzed bakery products. TFA content ranged between 0.17 g/100g to 0.22 g/100g of the product (mean=0.19 g/100 g of product). Expressed on percentage of fatty acids, the maximum value was 0.87 g/100 g fatty acids and the mean value was 0.68% (Ansorena et. al, 2013).TFA content in products from UK were found to be 0.01

g/100g of food in breakfast cereal without nuts, 0.01 g/100g of food in muesli type cereal with nuts, 0.05 to 0.14g/100g of food in low fat spreads, 0.07 g/100g of food in margarine, < 0.01 to 0.01 g/100g of food in potato chips, 0.01 to 0.16 g/100g of food in chocolates, 0.01 g/100g of food in instant soup, 0.04g/100g of food in mayonnaise and 0.01 to 1.38g/100g of food in butter (Department of Health-UK, 2013).

WHO (2013) has recommended to keep the TFA intake of less than 1% of the daily energy intake (i.e., about 2.2 g/day for a 2000 kcal diet) as the safe limit for chronic diseases prevention. A study involving 150 products from 12 Irish fast food outlets revealed that 23% of the products were high in TFA (≥2% of total fat) (FSAI, 2008). According to a study in Iran, trans fatty acids in fast foods (sausage, calbas, hamburgers and pizzas) were found to be 23.6% to 30.6% of total fatty acids (Asgary et. al, 2009). In US, major food sources of dietary TFA were cakes, cookies, pies, and pastries (Kris-Etherton et. al, 2012). TFA content of food products from Hongkong was found to be 0.33 g/100g in cream biscuits, 0.28g/100g in sweet biscuits, 0.20 g/100g in chocolates, 0.11 g/100g in spreads, 0.095 g/100g in instant noodles, 0.030 g/100g in instant soup and 0.081 g/100g in chips (Chung et. al, 2013). Various countries have taken initiatives to lower the PHVO content in food products. A study carried out in US on 360 branded products in 2007 found that they contained 0.5g TFA or more per serving. In 2008, 2010 and 2011, product labels were re-examined to determine TFA content. Ingredients lists were also examined in 2011 for partially hydrogenated vegetable oils (PHVO). TFA content was assessed for 270 products in all years between 2007 and 2011. It was found that by 2011, 178 (66%) of the 270 products had reduced TFA content. Most reformulated products (146 of 178, 82%) reduced TFA levels to less than 0.5 g per serving, although half of these 146 still contained PHVO. In all the 270 products, mean TFA content decreased by 49% between 2007 and 2011, from 1.9 to 0.9 g per serving. As TFA consumption is harmful even at low levels there is need for continued efforts toward reformulating or discontinuing foods that contain TFA (Otite et. al, 2013).

Similar study carried out in Delhi, India on commonly consumed snacks found a higher TFA content in biscuits (2.46 g/100g of food) as compared to the present study (Karn et. al, 2013). Though several studies on TFA content of commonly consumed snacks have been carried out in other parts of India but studies specifically on processed packaged foods are scanty. Agarwal et. al. (2008) reported high TFA content of 1.9% - 53% in unpackaged snacks. Similar study carried out in Delhi, India on trans fat content of commonly consumed savories/snacks revealed

that the TFA content was highest in mathari (7.33g/100g of food) followed by laddu (6.75g/100g of food), balushahi (5.72 g/100g of food), cake (2.7 g/100g of food), bhatura (2.5 g/100g of food), biscuit (2.46 g/100g of food), bread pakora (1.05 g/100g of food), samosa (0.25 g/100g of food) and bread (0.001g/100g of food). The study concluded that the variation in TFA content in snacks could have been due to the use of different blends of partially hydrogenated vegetable oils (PHVO) such as from different sources like soybean oil, canola oil, palm oil, corn oil and sunflower oil. The proportions of blends of hydrogenated and non-hydrogenated oils used in the foods are intentionally changed in order to get the desired physical properties of the food item. The TFA content in the same food varied with food outlets i.e. branded sweet shop or local sweet shop or roadside vendors (Karn et. al, 2013). Several studies from various parts of the world have also reported varied TFA level within similar food items due to type of oil used in preparation (McCarthy et. al, 2008; Huang et. al, 2006; Stachowska et. al, 2006; Albers et. al, 2008; Fu et. al, 2008). Thus, the variation observed in TFA content of foods makes it difficult to assess TFA intake in populations especially by dietary methods which depend on food composition data.

Food Composition of Selected Processed Packaged Foods According to United Kingdom- Food and Standards Agency (UK-FSA), 2007

Food labeling and recommendations regarding various nutrients is still in infancy stage in India. The FSSA of India has laid down general regulations for food labeling however, it has not recommended the safe limits of consumption of total fat, saturated fat, salt and sugars. Preliminary limits for nutrients such as “low fat” (≤3 g fat/100g of food), “low saturated fat” (≤1.5 g/100g of food), “low sugar” (≤5g/ 100g of food) , “low sodium” (≤ 0.12 g/100g of food) and “very low sodium” (≤0.04g/100g) have been prescribed. These recommendations are helpful in identifying food as “low” or “very low” in nutrients as the thresholds for “medium” and “high” are not prescribed and therefore under these circumstances the analyzed food products cannot be categorized as healthy or not healthy using FSSA guidelines (FSSAI, 2012). Therefore, to categorize food products as high, medium or low in total fat, saturated fat, salt and sugar the limits prescribed by UK-FSA have been used as given in the Table 4.3.19.

Table 4.3.19: Recommended Limits for Total Fat, Saturated Fat, Salt/Sodium and Sugar by UK-FSA, 2007

Nutrients	Low (Per 100g)	Medium (Per 100g)	High (Per 100g)
Fat	≤3 g	>3.0 to ≤20 g	>20 g
Saturated Fat	≤1.5 g	>1.5 to ≤5 g	>5 g
Salt	≤0.3 g	>0.3 to ≤1.5 g	> 1.5g
Sugars	≤5 g	>5.0 to ≤12.5 g	>12.5 g

Source: UK-FSA, 2007

Figure 4.3.3: Nutrients of Concern as Low, Medium or High in Analyzed Processed Packaged Foods as per UK-FSA Criteria (in percentage)

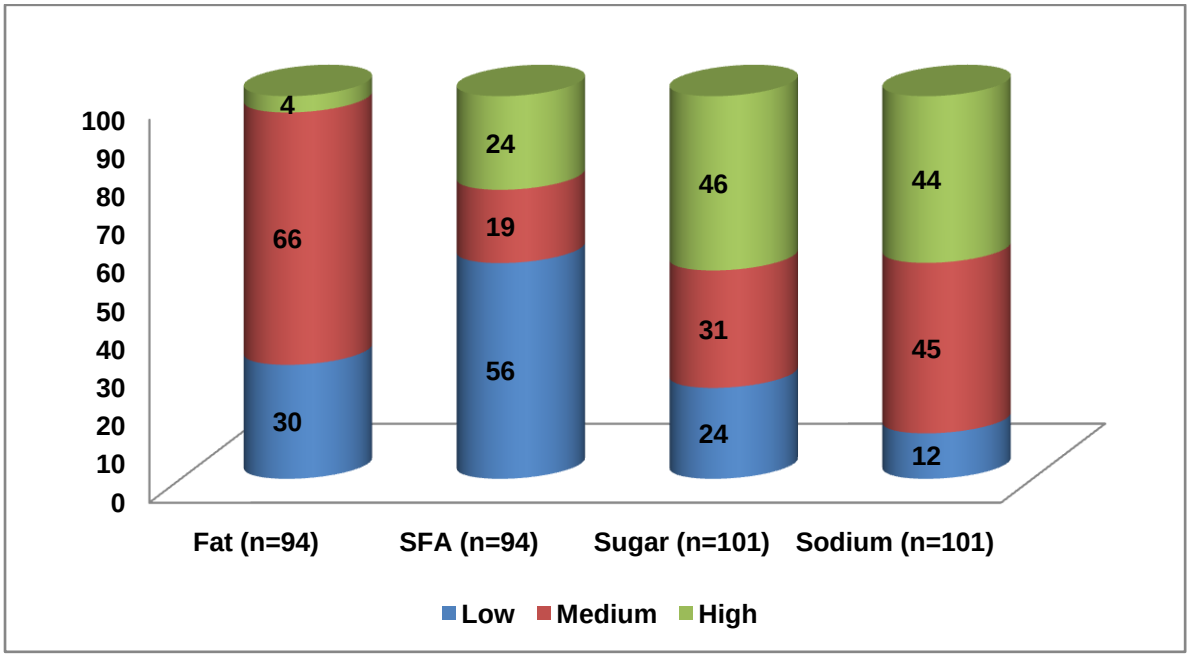


Figure 4.3.3 illustrate the percentage products having low, medium or high total fat, saturated fat, sugar and sodium content. It can be seen that 66% of the total products analyzed for fat had medium fat content, followed by 30% of the products with low fat content and only 4% of the products had high fat content. Saturated fat was low in 56% of the products, medium in 19% of the products and high in 24% of the products. Similarly, sugar was high in majority of the products (46%), medium in 31% products and low in 24% of the products. Few products (12%) were low in sodium content, 44% were high and 45% were medium in sodium content. The data revealed that majority of the products were high in sugar and sodium as compared to total fat

and saturated fat. Similar investigation carried out on 7,221 Australian products revealed that 63% of the food categories had mean sodium concentrations above the UK FSA targets. Many products, particularly breads, processed meats and sauces had salt values above reasonable benchmarks (Webster et. al, 2010). A study in New Zealand also showed that mean sodium content of processed foods were above UK FSA targets and similar products in UK market as well (Woodward et. al, 2012). Wherever the food products were found to be high in total fat, sugar or sodium, it was verified using ingredients list for the corresponding source of these nutrients for substantiation. If any source of fat, sugar or sodium was found at first three places in the ingredients list, then it was taken as substantiation by ingredients list. The reason for considering first three ingredients for substantiation is, as per the guidelines by FSSA the ingredients should be listed in decreasing order of weight percentage, which mean that the first three ingredients forms the major portion of the final food product.

Figure 4.3.4: Processed Packaged Foods High in Fat, Sugar and Sodium Content as per UK-FSA Criteria and Substantiation by Ingredients List (in percentage)

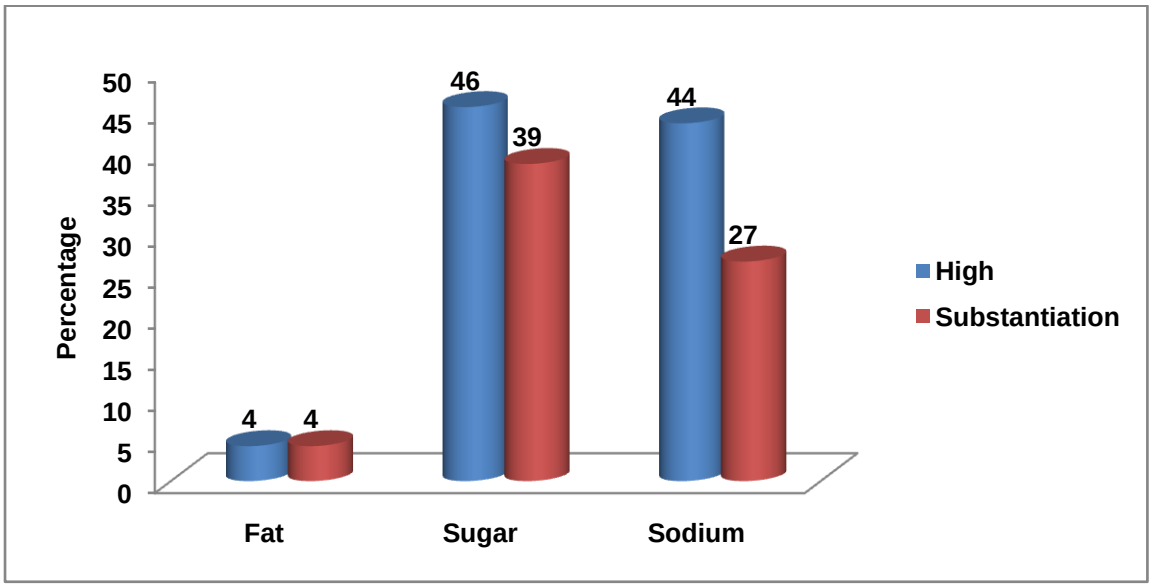


Figure 4.3.4 depicts the substantiation of high fat, sugar and sodium content by ingredients list. Substantiation of fat, sugar, sodium by ingredients list mean that the sources of these nutrients were among the first three ingredients in ingredients list. It can be seen that fat was completely substantiated by ingredients list. Sugar was high in 46% of the products and it was substantiated in 39% of the products. Likewise, high sodium content was found in 44% of the products, however it was substantiated

by ingredients list in 27% of the products only. Thus, complete substantiation was achieved only by fat.

Table 4.3.20: Processed Packaged Foods High in Sodium, Sugar, Total Fat and SFA as per UK-FSA Criteria by Various Food Categories (in percentage)

Sodium (% products)	Sugar (% products)	Total Fat (% products)	SFA (% products)
Butter and cheese (100)	Cereal and milk based baby foods (100)	Butter and cheese (100)	Butter and cheese (100)
Ketchups and sauces (100)	Ketchups and sauces (100)	Spreads and dips (50)	Namkeens and savories (64)
Noodles,pasta and macaroni (100)	Sweet cream wafers (100)	Chocolates (10)	Spreads and dips (50)
Soups (100)	Cakes (100)	Namkeens and savories (9)	Chocolates (50)
Ready-to-use spice mixes (100)	Malted beverages (100)		Noodles, pasta and macaroni (36)
Papads (100)	Canned fruits (100)		Sweet biscuits (21)
Namkeens and savories (55)	Jam, marmalades and jellies (100)		Chips (20)
Salty biscuits (50)	Ready to eat sweets (100)		
Ready-to-cook foods (50)	Chocolates (100)		
Spreads and dips (50)	Sweet biscuits (93)		
Pickles (50)	Ready-to-use spice mixes (67)		
Cornflakes, oats and muesli (42)	Soups (50)		
Chips (40)	Cornflakes, oats and muesli (33)		
	Namkeens and savories (9)		

Table 4.3.20show the percent products that were high in sodium, sugar, total fat and SFA in various food categories according to the US-FDA criteria. It can be seen from the table that all the analyzed products from food categories namely, noodles, pasta and macaroni, ketchups and sauces, soups, ready-to-use spice mixes, butter and cheese and papads and 50% of the products from food categories namely, namkeens and savories, salty biscuits, ready-to-cook foods, spreads and dips and papads were high in sodium. Remaining food categories had less than 50% of the products that were high in sodium. Sugar content was found to be high in all the products from cereal and milk based baby foods, sweet cream wafers, cakes, malted beverages, canned fruits, jam, marmalades and jellies, ketchups and sauces, ready to eat sweets and chocolates category while the same was high in 93% of the products in sweet biscuits, 67% of the products in ready-to-use spice mixes and 50% of the products in soups. All the products from butter and cheese category were high

in total fat and SFA. All the products from “ketchups and sauces” were high in sodium and sugar while “butter and cheese” were high in sodium, total fat and SFA. None of the products from food categories namely, popcorn, juices and soft drinks were high in any of the nutrients of concern. Food products from categories namely, “butter and cheese” and “ketchups and sauces” are usually consumed in small serving sizes and if few products from these categories are consumed less frequently then they may not contribute to high sodium, sugar, total fat and SFA intake.

Table 4.3.21: Processed Packaged Foods High in Two or More than Two Nutrients of Concern as per UK-FSA criteria

<table>
<tr>
<td>Products High In Sodium and SFA (n=8)
Ching's Schezwan Noodles
Horlicks Foodles Ala Masala (Green)
Maggi Masala
Maggi Thrillin Curry
Sunfeast yipee Magic Masala Noodles
Balaji Aloo Sev
Hippo (Baked Munchies) World Toasties Desi Chatpatta
Hippo World Toasties Mexican Cheese Jalapeno</td>
<td>Products High In Sugar and SFA (n=7)
Britannia Pure Magic Vanilla Creme
McVities Digestive
Parle Happy Happy
Cadbury Gems
Nestle Munch
Nestle Munch Rollz Caramel
Nestle Kit Kat Dark</td>
</tr>
<tr>
<td rowspan="3">Products High In Sodium and Sugar (n=8)
Kellogg's All Bran Wheat Flakes
Kissan Fresh Tomato Ketchup
Maggi Rich Tomato Ketchup
Knorr Classic Thick Tomato Soup
Tasty Treat Lemon Coriander Soup
Tasty Treat Hot Chinese Veg Soup
Suhana Paneer Tikka Masala
Suhana Khoya Kaju Mix</td>
<td>Products High In Total Fat and SFA (n=1)
Real Farali Chidwa Tikha</td>
</tr>
<tr>
<td>Products High In Sodium, Total Fat and SFA (n=2)
Nutralite Healthier Than Butter Table Spread
Amul Lite Bread Spread</td>
</tr>
<tr>
<td>Products High In Sugar, Total Fat and SFA (n=1)
Nestle Milkybar</td>
</tr>
</table>

Table 4.3.21 shows the food products which were high in two or more than two nutrients. A product was assumed to be unhealthy if two or more than two nutrients specified by UK-FSA were high. It was revealed that noodles and namkeens and savories were high in “sodium and SFA”, cornflakes, tomato ketchup, soups and ready-to-use spice mixes were high in “Sodium and Sugar”, sweet biscuits and chocolates were high in “Sugar and SFA” while namkeen and savories were high in “Total fat and SFA.” Food products that were high in 3 nutrients namely, “Sodium, Total fat and SFA” were butter and spread and high in “Sugar, Total fat and SFA” were chocolates. These products were also found to contain multiple sources of fat, sugar and sodium in ingredients list. Thus, UK-FSA guidelines can effectively identify and categorize foods as high, medium and low in nutrients of concern and help consumers make healthy food choices.

Fatty Acid Composition of Analyzed Processed Packaged Foods

Fat is a mixture of various fatty acids. The FAO Expert Consultation has grouped the fatty acids on the basis of single or double bonds between carbon atoms of fatty acid carbon chain. They are broadly classified into three groups namely, SFA, MUFA and PUFA. Saturated fatty acid contains no double bonds, MUFA contain one double bond and PUFA contain more than one double bond. PUFA are further classified based on the position of the first double bond from the methyl end of the carbon chain. Within the groups, individual fatty acids have distinct biological properties and thus varying effect on human health. Earlier low-fat diets have been recommended irrespective of the quality of fat but the current guidelines put more emphasis on the quality of fat (FAO, 2010). The quality of fat is precisely determined by the relative content of SFA, MUFA and PUFA including the proportion of essential fatty acids (linoleic acid (LA) and alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Schwab et. al, 2014). Quality of fat has shown a significant effect on serum lipid profile, blood pressure, endothelial function, low-grade inflammation and thus on the risk of CVD (Appel et. al, 1997; Graham et. al, 2007; Astrup et. al, 2011; Lopez-Garcia et. al, 2004; Uusitupa 2013). Therefore, in order to study the healthiness of the analyzed food products, a detailed analysis of fatty acid profile was carried out. A majority of Americans are concerned about the type of fat they consume. The study also shows that 71% Americans try to limit fats. Fifty six percent Americans try to focus on SFA, 49% on PUFA , 17% on PUFA, 8% omega 6-fatty acids and 6% omega 3-fatty acids (IFIC, 2011).

Table 4.3.22: Most Commonly found Fatty Acids in Analyzed Processed Packaged Foods and their Fat/Oil Sources

Fatty Acids	Abbrev-iation	N	N%	Mean (%g of total fat)	Range (%g of total fat)	Fat/Oil Source*
SFA						
Palmitic Acid	C16:0	75	79.8	19.4	0.1-105.4	Palm Oil and Animal Fats (sanders), Cottonseed oil
Arachidic Acid	C20:0	49	52.1	10.1	0.0-71.2	Peanut Oil
Stearic Acid	C18:0	47	50	9.5	0.0-56.3	Cocoa butter, hydrogenated fats, Cottonseed oil
Capric Acid	C10:0	43	45.7	2.3	0.0-17.1	Dairy Fat, Coconut and Palm Kernel Oils
Lauric Acid	C12;0	33	35.1	1.2	0.0-8.3	Coconut oil, Palm Kernel oil
Butyric Acid	C4:0	30	31.9	161.5	0.0-4776.4	Dairy Fat
Myristic Acid	C14:0	30	31.9	1.4	0.0-7.6	Dairy Fat, Coconut Oil, Palm Kernel Oil
Caproic Acid	C6:0	22	23.4	92.2	0.1-976.9	Dairy Fat
Caprylic Acid	C8:0	20	21.3	1	0.0-5.5	Dairy Fat, Coconut and Palm Kernel Oils
Behenic Acid	C22:0	13	13.8	2.1	0.1-15.9	Peanut Oil
Pentadecanoic Acid	C15:0	9	9.6	0.9	0.1-3.2	Milk Fat from Cow
Lignoceric Acid	C24:0	8	8.5	0.9	0.0-5.2	Peanut Oil
Tridecanoic Acid	C13:0	2	2.1	0.2	0.1-0.2	Dairy fat
Tricosenoic Acid	C23:0	1	1.1	0.1	0.1-0.1	Dairy fat
MUFA						
Oleic Acid	C18:1 Δ9c	85	90.4	37.7	0.1-452	Olive oil, sunflower and safflower oil,rapeseed oil, palm oil, Cottonseed oil
Erucic Acid	C22:1 Δ13c	36	38.3	8.7	0.0-49	Mustard oil, Rapeseed oil
Myristoleic Acid	C14:1	2	2.1	0.4	0.2-0.7	Nutmeg
Palmitoleic Acid	C16:1Δ9c	2	2.1	1.5	0.5-2.5	Marine oils, macadamia oil,most animal and vegetable oils
PUFA						
Linoleic Acid	C18:2n6c	67	71.3	31.6	0.0-456.1	Safflower, sunflower, corn oil, soyabean oil
Linolenic Acid	C18:3n3	37	39.4	7.3	0.0-46.2	Flaxseed, Soyabean
Arachidonic Acid	C20:4n6c	5	5.3	8.8	0.0-35.5	Animal Fats, Liver, Egg Lipids and Fish
TFA						
Elaidic Acid	C18:1n9t	22	23.4	9.6	0.1-41.7	Partially hydrogenated fats
Linolelaidic Acid	C18:2n6t	17	18.1	65.6	0.2-914.5	Partially hydrogenated fats/oils

***Source: FAO, 2010; Sanders, 2003 and Agarwal et. al, 2003**

Table 4.3.22 lists the most commonly found fatty acids in analyzed food products. The data reveal that majority of the food products contained Oleic acid (90.4% food products) followed by Palmitic acid (79.8%), Linoleic acid (71.3%), Arachidic acid (52.1%), Stearic acid (50%), Capric acid (45.7%), Linolenic acid (39.4%), Erucic acid (38.3%), Lauric acid (35.1%), Myristic (31.9%), Butyric (31.9%), Elaidic acid (23.4%), Caproic acid (23.4%), Caprylic acid (21.3%), Linolelaidic acid (18.1%), Behenic acid (13.8%) and the remaining fatty acids were found in less than 10% of the food products. It is to be noted that majority of these fatty acids constitutes SFA (Palmitic acid, Arachidic acid, Stearic acid, Capric acid, Lauric acid, Myristic acid, Butyric acid, Caproic acid, Caprylic acid and Behenic acid). Oleic acid and erucic acid constitutes MUFA, linoleic acid constitutes PUFA and elaidic and linolelaidic acid constitutes TFA. Therefore, a large number of food products had SFA content. The predominant fatty acid (as the mean percent of total fatty acids) was Butyric acid- 161.5% of total fatty acids, followed by Caproic acid- 92.2% of total fatty acids, Linolelaidic acid- 65.6% of total fatty acids, Oleic acid- 37.7% of total fatty acids and Linoleic acid- 31.6% of total fatty acids, Palmitic acid- 19.4% of total fatty acids and Arachidic acid- 10.1% total fatty acids. Butyric acid in the food products ranged from 0 to 4776.4%, Caproic acid- 0.1 to 976.9%, Linolelaidic acid- 0.2 to 914.5%, Linoleic acid- 0 to 456.1% and Palmitic acid- 0.1 to 105.4%. The first three fatty acids with highest percent means of total fatty acids belonged to SFAs and TFAs and thus indicate that products had reasonably high amount of SFA and TFA content.

Studies have shown that individual saturated fatty acids (SFAs) have different effects on the concentration of plasma lipoprotein cholesterol fractions. For example, lauric acid (C12:0), myristic acid (C14:0) and palmitic acid (C16:0) increases LDL cholesterol whereas stearic acid (C18:0) has no effect on the same. LDL cholesterol concentration and the total/HDL cholesterol ratio decreases when SFA is replaced with PUFA. A similar but lesser effect was seen when SFA was replaced with MUFA. Replacing SFA with TFA decreases HDL cholesterol and increases the total/HDL cholesterol ratio. Therefore, when SFA is replaced with PUFA the risk of CHD decreases and thus it is recommended that SFA should be replaced with PUFA in the diet and the total intake of SFA should not exceed 10% of the total energy (FAO, 2010).Similarly, studies have shown that TFAs lead to a high LDL, low HDL cholesterol and have positive association with cardiovascular disease and diabetes (Akoh and Lai, 2005). Studies have also shown that consumption of TFA leads to a LDL/HDL cholesterol ratio worse than SFAs (Zock et. al, 1996).

MUFAs are considered to be hypocholesterolaemic but less effective than PUFA. MUFAs have been associated with improved insulin sensitivity and are more resistant to oxidative modification (Hu et. al, 2001). A study among Mediterranean population found that cardiovascular disease mortality was lower among the subjects as olive oil was the primary fat source in their diet which is high in oleic acid (Nicklas et. al, 2004).

Table 4.3.22 also enlists the fat/oil sources of fatty acids. The most important dietary sources of fatty acids are vegetable oils, dairy products, meat products, grains and fish oils. Saturated fatty acids are straight chain hydrocarbon with an even number of carbon atoms and no double bonds between carbon atoms. The most common SFAs contain 12-22 carbon atoms. Palmitic acid (16:0) is the most common SFA found in animals, plants and microorganisms. Stearic acid (18:0) is a major fatty acid in animals and less common in plants. Myristic acid (14:0) is widely found in animal and plant sources but in small concentrations (Arild et. al, 2005). Monounsaturated fatty acids have one carbon-carbon double bond, which can occur in different positions. The remaining carbon atoms are single bonded. The most common MUFAs contain 16-22 carbon atoms and a double bond with the cis-configuration. Oleic acid (18:1 omega 9) is the most common MUFA in plants and animals. It is also found in microorganisms. Palmitoleic acid (16:1 omega-7) occurs widely in animals, plants and microorganisms and is a major component of some seed oils (Arild et. al, 2005).

Polyunsaturated fats contain two or more carbon-carbon double bonds. When the double bond is at the third carbon atom from the omega (methyl) carbon, these are called omega-3 fatty acids and when the double bond is at the sixth carbon atom, then they are called omega-6 fatty acids. The double bonds in PUFAs are separated from each other by a methylene group. PUFAs, which are produced only by plants and phytoplankton, are essential for all higher organisms, including mammals and fish. Linoleic acid (18:2 omega-6) is a major PUFA in plant lipids. Arachidonic acid (20:4 omega-6) is a major component of membrane phospholipids throughout the animal kingdom, but very little is found in the diet. Alpha-Linolenic acid (18:3 omega-3) is found in higher plants (soyabean oil and rape seed oils) and algae (Arild et.al, 2005).

TFAs contain one or more double bonds in trans geometric configuration. Trans isomers may be produced during industrial processing (hydrogenation) of unsaturated oils and in the gastrointestinal tract of ruminants. Vaccenic acid is the

naturally occurring TFA while elaidic and linolelaidic acid are most commonly found industrially produced TFAs (Basset et. al, 2010; Arild et. al, 2005).

Animal fat such as beef and lamb fat, lard, skin from poultry, milk fat e.g. cream, butter, cheese and other dairy products made from whole or low-fat (2%) milk and some vegetable fats are important sources of saturated fat in the diet. Many confectionery products, commercially prepared snacks and fried food such as convenient food or fast food can also contain high levels of saturated fats .Olive and canola oils, nuts and avocados are the major non-animal sources of MUFA. These vegetable oils also contain antioxidants and various isomers of vitamin E while animal MUFA sources contain less antioxidants (Chong et. al, 2006).TFA refers to the major trans fatty acids in human diet which are typically derived from partially hydrogenated vegetable oils. TFA from commercial partially hydrogenated vegetable oils (PHVOs) increases CHD risk factors and CHD events more than animal derived TFAs (FAO, 2010). TFAs are found in shortenings, margarines, industrial cooking oils and are commonly found in processed foods such asfast foods, french fries, donuts, cookies, dry soup powder sand pastries (Chong et. al, 2006).

A follow-up study (6.3 years long) conducted among US subjects (865 men and 472 women) to assess the association between intakes of fat, fat subtypes and fat food sources and exocrine pancreatic cancer revealed that pancreatic cancer risk was directly related to the intake of total fat but not polyunsaturated fat. The associations were strongest for saturated fat from animal food sources specifically, intakes from red meat and dairy products (Thiebaut et. al, 2009). Another study (prospective cohort) from US was carried out to examine the association between intake of fat subtype and individual fatty acids (FAs) and the risk of developing hypertension among 28,100 women aged ≥39 years. A total of 13,633 women developed incident hypertension during 12.9 years of follow-up. After adjusting for demographic, lifestyle and other dietary factors, higher intake of SFAs, MUFAs and TFAs were associated with increased risk of hypertension among middle-aged and older women, whereas only association for TFAs remained statistically significant after adjustment for obesity-related factors (Wang et. al, 2010).

Table 4.3.23: Mean Fatty Acid (%g of total fat) Composition of Analyzed Processed Packaged Foods in Various Food Categories (*Red: First Highest Mean, Yellow: Second Highest Mean, Blue: Third Highest Mean)*

FATTY ACIDS	CEREAL AND MILK BASED BABY FOODS	CORNFLAKES, OATS AND MUESLI	NOODLES, PASTA AND MACARONI	SALTY BISCUITS	SWEET BISCUITS	SWEET CREAM WAFERS	CAKES	CHIPS	NAMKEENS AND SAVORIES	POPCORN	MALTED BEVERAGES	READY TO COOK FOODS	READY TO EAT SWEETS	SOUPS	READY-TO-USE SPICE MIXES	BUTTER AND CHEESE	SPREADS AND DIPS	CHOCOLATES	PICKLES	PAPADS
BUTYRIC	_	0.9	955.6	_	0.9	0.5	1.0	_	3.5	0.0	_	1.2	_	0.5	2.7	1.2	1.7	9.1	1.3	_
CAPROIC	_	1.4	1.1	_	_	_	_	619.9	346.7	10.0	_	_	_	0.1	0.1	0.1	0.9	0.7	_	_
CAPRYLIC	_	1.0	1.2	0.1	0.1	_	_	_	0.5	0.0	_	_	_	0.7	0.0	0.7	0.3	3.1	0.2	_
CAPRIC	_	1.9	2.3	_	6.2	0.5	0.9	0.2	1.4	0.0	_	0.2	1.1	1.8	1.8	0.4	7.2	2.4	0.1	_
LAURIC	_	1.0	1.8	0.3	0.7	_	_	0.7	0.4	0.1	_	0.5	8.3	0.8	1.4	_	2.0	0.7	0.4	_
TRIDECANOIC	_	0.2	_	_	_	_	_	_	_	_	_	_	_	0.1	_	_	_	_	_	_
MYRISTIC	_	0.2	1.3	_	0.5	_	_	1.6	1.2	0.0	0.1	1.0	4.4	0.9	1.3	_	_	5.0	_	_
MYRISTOLEIC	_	_	0.7	_	_	_	_	_	_	_	_	_	_	0.2	_	_	_	_	_	_
PENTADECANOIC	_	0.2	0.5	_	_	_	_	0.2	3.2	0.1	_	1.4	1.7	0.8	_	_	_	_	_	_
PALMITIC	13.5	14.0	36.8	11.8	11.6	6.0	15.7	1.0	31.2	0.5	0.1	3.8	1.6	18.1	11.3	5.7	15.0	31.1	9.4	_
PALMITOLEIC	_	0.5	_	_	_	_	_	_	_	_	_	_	_	_	2.5	_	_	_	_	_
STEARIC	9.6	5.6	13.0	56.3	9.0	2.8	6.9	1.4	26.9	0.2	_	2.3	7.4	2.0	6.0	2.4	2.9	14.6	19.9	_
ELAIDIC	_	2.6	6.8	29.6	3.4	_	_	_	10.0	_	1.8	_	28.3	2.5	24.5	_	9.3	_	_	_
OLEIC	234.6	34.8	33.3	9.3	28.4	38.6	106.9	39.4	36.5	1.9	5.1	50.5	150.8	30.8	17.7	36.0	37.8	17.3	44.6	28.2
LINOLELAIDIC	914.5	175.7	0.6	_	0.4	0.8	_	_	0.7	_	0.9	_	_	3.2	0.7	_	3.3	4.0	1.9	_
LINOLEIC	229.8	39.4	16.1	_	20.5	2.5	216.7	26.1	16.3	_	24.9	26.6	0.8	35.3	16.1	3.7	0.2	24.8	18.9	3.5
ARACHIDIC	13.0	20.9	8.0	0.1	5.8	25.8	_	8.2	13.3	_	5.5	0.9	3.0	12.1	4.5	28.7	0.2	7.2	7.2	20.6
LINOLEINIC	7.0	10.0	2.8	_	2.8	10.9	_	1.4	6.5	_	2.6	1.0	5.1	0.5	6.7	_	0.8	25.5	0.7	_
BEHENIC	_	0.3	1.0	_	15.9	_	_	0.8	_	_	_	1.5	_	0.2	0.1	_	3.8	0.8	_	_
ARACHIDONIC	35.5	_	1.4	_	_	_	_	_	_	_	0.2	_	_	_	0.0	_	6.8	_	_	_
ERUCIC	8.4	1.5	1.3	_	4.6	2.9	_	26.8	16.9	_	1.8	24.8	_	1.8	0.2	7.3	26.5	0.2	_	42.4
LIGNOCERIC	_	0.3	_	_	_	_	_	0.6	0.1	_	_	0.4	_	_	_	0.0	0.2	_	_	5.2
TRICOSENIC	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	0.1	_	_	_

Table 4.3.23 show the presence of various fatty acids in food products. From the table it can be inferred that majority of the food products were high in oleic acid. Ready-to-eat sweets, ready-to-eat foods, pickles, sweet cream wafers, spreads and dips, butter and cheese and sweet biscuits had oleic acid content of 150.8%, 50.5%, 44.6%, 38.6%, 37.8%, 36% and 28.4% respectively. Oleic acid is a monounsaturated fatty acid and most commonly present in olive oil, canola oil, sunflower and safflower oil (FAO, 2010). Oleic acid has been found to have positive effect on insulin. Oleic acid and peanut oil high in oleic acid enhance insulin production in insulin secreting cell line (INS-1). Oleic acid was found to be effective in reversing the inhibitory effect in insulin production of the inflammatory cytokine TNF-α. Therefore, a diet high in oleic acid, which can be easily achieved through consumption of peanuts and olive oil, can have a beneficial effect in type-2 diabetes and ultimately reverse the negative effects of inflammatory cytokines observed in obesity and non-insulin dependent diabetes mellitus (Vassiliou et. al, 2009). Several other studies have proved that oleic acid and oleic acid rich foods may have beneficial health effects such as improved insulin sensitivity and endothelium-dependent flow mediated vasodilatation, lowering of LDL cholesterol and an increase in HDL cholesterol and reduced blood pressure (Hostmark and Haug, 2013; Ryan et. al, 2000; Gillingham et. al, 2010; Damasceno et. al, 2011; Estevez-Gonzalez et. al, 2010; Teres et. al, 2008). Thus, oleic acid have anti-carcinogenic and anti-inflammatory effects leading to reduced risk of CVD (Vassiliou et. al , 2009; Reardon et. al , 2012; Urpi-Sarda et al, 2012).

Cereal and milk based baby foods and cornflakes, oats and muesli were found to be high in linolelaidic acid which is a trans fat derivative. Mean percent linolelaidic acid content in both the food categories were 914.5% and 175.7% respectively. Noodles, pasta and macaroni were high in butyric acid (955.6%). Butyric acid typically comes from dairy fat (Sanders and Emery, 2003). Linoleic acid content was 216%, 35.3% and 24.9% in cakes, soups and malted beverages, respectively. Diet with increasing intake of linoleic and linolenic acids increase HDL-cholesterol and decreases LDL-cholesterol, while higher intake of oleic acid decreases LDL-cholesterol, but does not affect HDL cholesterol levels (Lawton et. al, 2000). Caproic acid was found to be high in chips, namkeens and popcorn i.e. 619.9%, 346.7% and 10%, respectively. Stearic acid was 56.3% in salty biscuits and elaidic acid was 24.3% in ready-to-use spice mixes. Palmitic acid was as high as 31.1% in chocolates and erucic acid (42.4%) in

papads. A study conducted in Netherlands among 36 women and 23 men to test three diets that differed from each other in palmitic, oleic and myristic acid content by about 10% of total energy. Results revealed that myristic acid and palmitic acid diet led to high LDL cholesterol and apo B levels and low HDL/LDL ratios. Thus, diets for the treatment of hypercholesterolemia should be low in myristic and palmitic acids (Zock et. al, 1994).Study conducted on rat model revealed that high palmitic acid diet resulted in reduced insulin activity (Benoit, 2009)**.** A study carried out in Delhi, India on trans fat content of commonly consumed snacks revealed that the predominant trans fatty acid present in the food items was elaidic acid (18:1t9) which is a trans fatty isomer indicating that Indian snacks contain TFAs (Karn et. al, 2013). A study involving 150 products from 12 Irish fast food outlets revealed that the most commonly identified TFA isomers were Elaidic Acid (C18:1), Vaccenic Acid (C18:1), Palmitelaidic Acid (C16:1), Linolelaidic Acid (C18:2) and Brassidic Acid (C22:1) (FSAI, 2008). According to a study in Iran the most common saturated fatty acids in Iranian fast foods was stearic acid (C18:0) which ranged from 14.0% to 20.9%. Saturated fatty acid content in calbas (Iranian sausages) was significantly higher than that found in other groups namely, sausages, hamburgers and pizzas. Trans fatty acids constituted almost 23.6% to 30.6% of total fatty acids of these products. The most common TFA in these fast foods was elaidic acid (C18:1 9t). Total cis unsaturated fatty acid content of analyzed fast foods varied from 25.3% (in sausage) to 46.8 (in calbas) with oleic acid (C18:1 9c) followed by linoleic acid (C18:2) being the most common fatty acids in these products. This study showed higher TFA content in commercially available fast foods compared to the amounts recommended by dietary guidelines in Iran (Asgary et. al, 2009).

Table 4.3.24: Types of Fat Declared in the Ingredients List in various Food Categories

Food categories	Types of fat listed on ingredients list	Possible source of oil/fat according to the fatty acids present in the food category
Cereal and milk based baby foods	Corn Oil	Hydrogenated fat/oil, olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, Cottonseed oil and soyabean oil
Cornflakes, oats and muesli	Edible vegetable oil	Hydrogenated fat/oil, olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, Cottonseed oil and soyabean oil
Noodles, pasta and macaroni	Edible vegetable oil, hydrogenated vegetable oil, margarine	Dairy fat, palm oil and animal fats
Salty Biscuits	Edible vegetable oil, hydrogenated vegetable oil, hydrogenated vegetable fat, bakery shortening	Cocoa butter, hydrogenated fat, palm oil and animal fats, Cottonseed oil
Sweet biscuits	Edible vegetable oil, hydrogenated vegetable fat/oil, partially hydrogenated vegetable oil, butter, cocoa butter, bakery shortening, hydrogenated edible vegetable oil	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, soyabean oil, Cottonseed oil and peanut oil
Sweet cream wafers	Edible hydrogenated vegetable fat	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, Cottonseed oil and peanut oil
Cakes	Edible vegetable oil	Palm oil, animal fats, olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, Cottonseed oil and soyabean oil
Chips	Edible vegetable oil	Dairy fat, mustard oil, rapeseed oil, olive oil, safflower oil, sunflower oil, Cottonseed oil and palm oil
Namkeens and savories	Edible oil, Edible vegetable oil	Dairy fat, palm oil, animal fat, sunflower oil, safflower oil, rapeseed oil, Cottonseed oil and olive oil
Popcorn	Edible vegetable fat	Dairy fat, palm oil, animal fat, sunflower oil, safflower oil, rapeseed oil and olive oil
Malted beverages	Peanut oil	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, peanut oil and soyabean oil
Ready to cook foods	Edible vegetable oil, bakery shortening, palmolein oil and sesame oil	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, soyabean oil, Cottonseed oil and mustard oil
Ready to eat sweets	–	Cocoa butter, hydrogenated fat/oil, olive oil, sunflower oil, safflower oil, Cottonseed oil rapeseed oil and palm oil

Soups	Edible vegetable oil/fat	Palm oil, animal fats, olive oil, safflower oil, sunflower oil, rapeseed oil, corn oil, Cottonseed oil and soyabean oil
Ready-to-use spice mixes	Cottonseed oil	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, Cottonseed oil, soyabean oil and hydrogenated oil/fat
Butter and cheese	Edible vegetable oil	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, peanut oil , Cottonseed oil and ,mustard oil
Spreads and dips	Edible vegetable oil, refined vegetable oil	Palm oil, animal fats, olive oil, safflower oil, sunflower oil, rapeseed oil, Cottonseed oil and mustard oil
Chocolates	Edible vegetable oil, hydrogenated oil, hydrogenated vegetable fat, cocoa butter, cream, partially hydrogenated vegetable oil, sesame oil	Sunflower oil, safflower oil, soyabean oil, corn oil, palm oil and animal fat
Pickles	Edible vegetable oil	Cocoa butter, hydrogenated fat/oil, corn oil, soyabean oil, olive oil, sunflower oil, safflower oil, rapeseed oil, Cottonseed oil and palm oil
Papads	Cottonseed oil	Olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, peanut oil, Cottonseed oil and mustard oil

Data presented in Table 4.3.24 shows that majority of the food groups declared the source of fat in ingredients list as “edible vegetable oil.” Listing of edible vegetable oil as a source of fat does not give adequate information about kind of fat or oil used in the manufacture of the product. In few food categories the specific source of fat or oil had been declared namely, margarine, palmolein oil, cocoa butter, butter, sesame oil, peanut oil and corn oil. As can be seen from the Table 4.3.23, Cereal and milk based baby foods had major portion of linolelaidic acid (source: hydrogenated fat/oil), oleic acid (source: olive oil, sunflower oil, safflower, rapeseed, palm oil) and linoleic acid (source: sunflower, safflower, corn oil, soyabean oil) but the fat source listed in the ingredients list was corn oil only. However, the probable source according to the fatty acid profile could be any or a blend of the oils namely, hydrogenated fat/oil, olive oil, safflower oil, sunflower oil, rapeseed oil, palm oil, corn oil, Cottonseed oil or soyabean oil. Though, cereal and milk based baby foods were found to have linolelaidic acid which comes from hydrogenated fat/oil, yet no such fat source was listed in the ingredients list. Cereal and milk based baby foods, cornflakes, oats and muesli, cakes, chips, namkeens and savories, popcorn, soups, butter and cheese,

spreads and dips and pickles declared the sources of fat in ingredients list as edible vegetable oil/fat. Due to the incomplete and non-specific declaration of fat source, inappropriate information is conveyed to the consumer which is a matter of public health concern. These products were however found to contain fatty acids which are derived from palm oil, hydrogenated fat, dairy fat, animal fat and thus may have negative effect on cardiovascular health. It can be observed from the Table 4.3.24, that the most common probable source of oil in foods was palm oil. The reason for using palm oil in food products could be its chemical properties. According to Nor-Aini and Miskandar (2007), palm oil is frequently used in the production of bakery products as it contains an equal amount of unsaturated and saturated fatty acids. Palm oil contains palmitic acid, the main saturated fatty acid that naturally crystallizes into beta crystals imparting a smooth texture to the fat and extends the shelf life (Ghotra et. al, 2002; Narine and Marangoni, 1999). Palm oil is stable oil as it has a low level of linoleic acid and contains no linolenic acid. Palm oil also has a high melting point and solid fat content while the other liquid oils have to be hydrogenated to meet the requirements and the palm oil requires no further modification or chemical processing (Timms, 1985). These are the reasons that palm oil is increasingly used in processed food industries especially bakery industry. However, few studies have found negative health effects of palm oil consumption due to the relatively high content of saturated fatty acids (SFAs), particularly palmitic acid, which is associated with increased risk of coronary heart disease and some tumors. However, more recent investigations on the topic seem to have reconsidered the negative role of the dietary SFAs as a risk factor for cardiovascular diseases and show that not only the type of fat, but also that the triglyceride structure plays a role in cholesterolaemia (Fattore and Fanelli, 2013). Palmitic acid does not adversely impair insulin secretion and glucose homeostasis (Filippou et. al, 2014). A randomized crossover intervention carried out on 45 Malaysian healthy adults showed that the diets rich in saturated fatty acids prepared with either palm oil or coconut oil and olive oil that was high in oleic acid did not alter postprandial or fasting plasma concentrations of homocysteine and inflammatory markers (TNF-a, IL-1b and 8 hs-CRP and interferon-c) (Voon et. al, 2011). Alireza et. al. (2010) and Soliman et. al. (2006) have reported that Palmitic acid (16:0) content increased with the prolonged frying of oils where as linoleic acid (18:2) and linolenic acid (18:3) fatty acid content decreased. Similarly, Soliman et. al. (2006) found the increase in the content of palmitic, stearic and total saturated fatty acid with increased frying time. Repeated use of oil for frying introduces components in the food that increases health risk.

Cottonseed oil was also found to be the most common probable source of fat/oil in the studied products. Cottonseed oil is largely composed of linoleic acid which is a polyunsaturated fatty acid. The PUFA content of cottonseed oil is three times as much as SFA content and therefore it is considered as a healthy vegetable oil and is one of the few oils recommended for reducing saturated fat intake. As it is extracted from plant, cottonseed oil is cholesterol free. The use of cottonseed oil in food processing industry is increasing as it is "naturally hydrogenated" oil due to the appreciable levels of oleic, palmitic and stearic acids. This property of cottonseed oil makes it stable frying oil with no requirement of further processing that could lead to the formation of trans fatty acids. Cottoseed oil when hydrogenated to an Iodine Value of about 80, its fatty acid profile changes to 50% monounsaturated, 21% polyunsaturated and 29% saturates which still remains within health guidelines. Another benefit of cottonseed oil is that it contains natural antioxidant (tocopherols) that contribute to its longer shelf life. Cottonseed oil is light, non oily and has high smoke point which makes it most desirable for frying (Agarwal et. al, 2003). Cottonseed oil is largely used in deep fried products (flavor carrier), baking (as blends with fully hydrogenated cottonseed oil with partially hydrogenated creates good shortening), margarines, icing and whipped toppings (provide consistent texture and smooth creamy appearance) and salad dressings (oxidation free dressings)(http://www.cottonseed.com/aboutncpa/default.asp).

Phase IV: Consumer Awareness and Capacity Building on Food Labeling

The Phase-I of the study on “Situational Analysis of Processed Food Consumption among the Consumers” revealed the most commonly consumed processed packaged foods among 807 enrolled consumers in the study and the Phase-II deliberated the status of food labeling in Indian processed packaged foods. Both the Phases I and II brought in the necessity to carry out Phase-IV to assess knowledge, practices and comprehension skills related to processed packaged food consumption among the consumers. Therefore, to fulfill this aim, a consumer survey on the previously enrolled 807 subjects from Phase-I were interviewed and their responses were recorded using pre-tested semi-structured questionnaire. Consumer survey was carried out in three sub-phases as given below,

Sub-phase IV (a): Consumer awareness and practices survey

Sub-phase IV (b): Development of intervention tools and capacity building of the consumers

Sub-phase IV (c): Impact evaluation after intervention

Sub-phase IV (a): Consumer Awareness and Practices Survey

Results presented in this section highlights the prevalent practices among consumers towards processed food selection, factors influencing processed food selection and knowledge about food labeling.

Figure 4.4.1: Reasons for Processed Packaged Food Consumption by the Consumers in Total Population (in percentage)

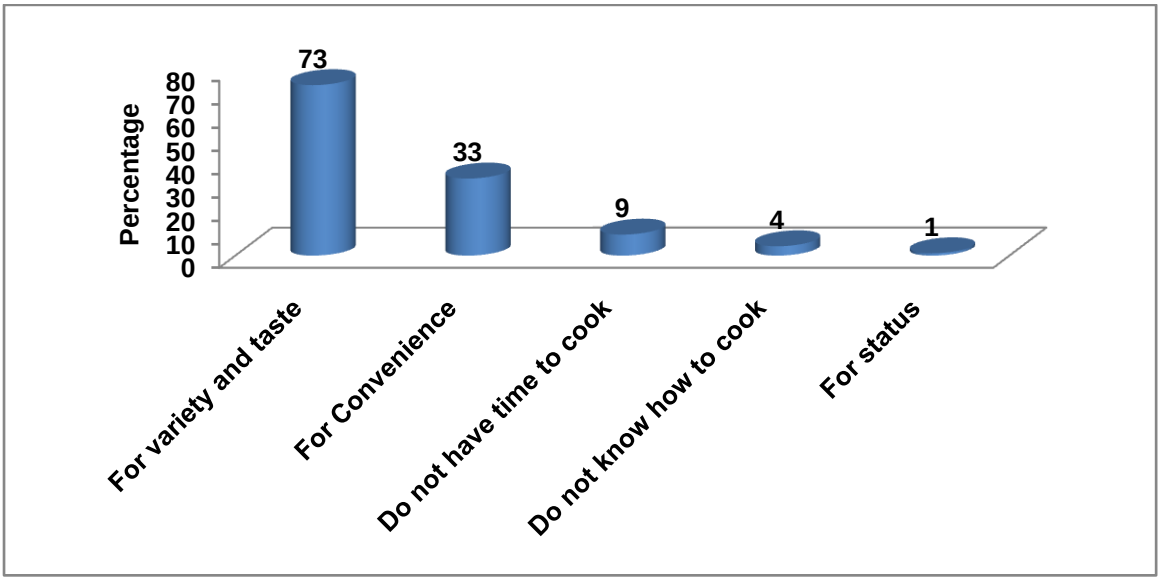
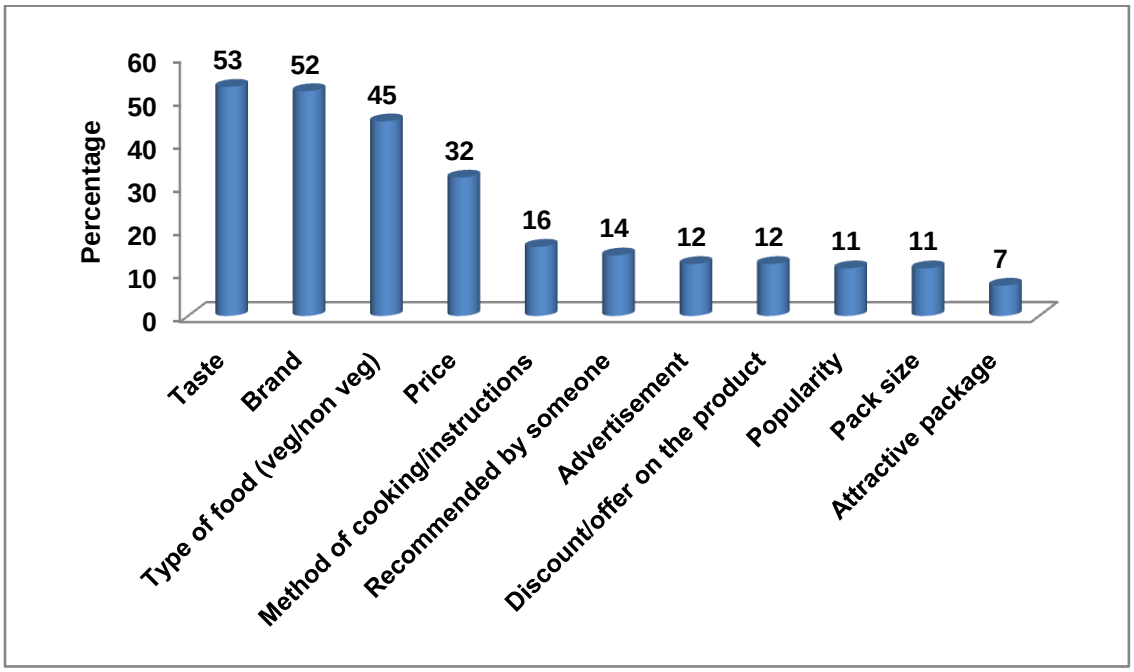


Table 4.4.1: Reasons for Processed Packaged Food Consumption by the Consumers- Gender and Age-group wise (in percentage)

Gender and Age Groups	Consumer Responses (%)				
	For Convenience	Do not have time to cook	Do not know how to cook	For variety and taste	For status
Adolescent Boys (n=135)	5	2	2	13	1
Adolescent Girls (n=212)	6	1	1	21	0
Adult Males (n=99)	6	3	0	7	0
Adult Females (n=210)	10	3	1	20	0
Elderly Males (n=76)	4	0	0	7	0
Elderly Females (n=75)	3	0	0	6	0

Figure 4.4.1 show the reasons for consumption of processed foods by the consumers. Of the five major reasons namely, “convenience”, “do not have time to cook”, “do not know how to cook”, “variety and taste” and “status”, the prime factors for processed food consumption were, variety and taste (73%) and convenience (33%). Table 4.4.1 delineates the gender and age-groupwise data on reasons reported by the consumers for processed food consumption. “Variety and taste” and “convenience” were the most common cited reasons by all age-groups and gender for processed food consumption. A higher percentage of female respondents (47%) cited the same as compared to males (19%). Reasons namely, “do not have time to cook” (5%) and “do not know how to cook” (2%) were quoted more frequently by males. Adolescents consumed processed foods for “variety and taste” (34%), “for convenience” (11%), “do not have time to cook” (3%), “do not know how to cook” (3%) and for “status” (1%). Similar results were observed in a study conducted in US. It demonstrated that taste (87%) and convenience (58%) were among the top four influencers towards processed food purchase (IFIC, 2011).

Figure 4.4.2: Non-Nutritional Factors Considered by the Consumers while Purchasing Processed Packaged Foods (in percentage)



Results demonstrated in Figure 4.4.2 highlight the non-nutritional factors considered by the consumers while purchasing processed foods. Self-reported behavior of the consumers showed that the factors namely, taste (53%), brand (52%) and type of

food (vegetarian/non-vegetarian) (45%) were the predominant factors that consumers kept in mind while purchasing processed packaged foods. These factors were followed by other determinants like price (32%), cooking method (16%), recommendation from family, friends, health professional etc. (14%), discount and advertisement (12% each), popularity and pack size (11% each) and attractive package (7%). Similar to the present study, an investigation by Chandorkar and Joshi (2012), identified brand (81%) and taste (63%) as the top two determinants of processed foods purchase by the consumers in Vadodara. Other factors considered by consumers for product purchase in the study by Chandorkar and Joshi (2012) were price (53%), type of food (veg/nonveg) (48%), recommendation by someone (19%), product popularity (15) and advertisements (15%).

Table 4.4.2: Non-Nutritional Factors Considered by the Consumers while Purchasing Processed Packaged Foods- Gender and Age-group wise (in percentage)

Non-nutritional Factors	Gender and Age-Groups					
	Adolescent Boys (n=135)	Adolescent Girls (n=212)	Adult Males (n=99)	Adult Females (n=210)	Elderly Males (n=76)	Elderly Females (n=75)
Taste	9	14	7	16	3	3
Brand	9	13	7	14	5	3
Type of food (veg/non veg)	10	12	4	14	3	3
Price	9	10	4	7	1	1
Method of cooking/instructions	3	5	2	5	1	1
Recommended by someone	2	4	2	4	0	1
Advertisement	2	3	2	3	2	0
Discount/offer on the product	3	2	2	4	1	0
Popularity	4	2	1	3	0	0
Pack size	3	2	1	3	1	0
Attractive package	2	3	1	1	0	0

As shown in Table 4.4.2 males made food choices according to the brand (21%), taste (20%), type of food (vegetarian/non-vegetarian) (16%), price (14%) and discount (6%) The selection of processed foods among females depended on taste (33%), brand (31%), type of food (vegetarian/non-vegetarian) (29%), price (18%), cooking method (11%), recommendation from family/friends/health professionals (9%) and advertisement (7%). In all age-groups, brand, taste and type of food (vegetarian/non-vegetarian) were the most commonly considered factors by the

subjects for processed food purchase. Similar results were observed in a cross-sectional study conducted in two metro cities in India namely, New Delhi and Hyderabad. Taste, quality, convenience and ease of use were the main reasons for buying pre-packaged foods (Vemula et. al, 2013). Studies from other countries namely US also showed similar consumer behavior towards processed food purchase. It was observed that 38% of Americans followed recommendation from friends and family and 28% from medical professionals for processed food selection. Price (79%) was the second prime influencer for product selection (IFIC, 2011). In another study, price was an intermediate factor while availability and peer influence were the least important factors for such behavior (Kumar and Ali, 2011a). A study consucted in Maseru, South Africa showed that less than half of the participants (40.5%) preferred nutrition information on food labels, rather than price, taste, appearance, habit, convenience or brand name. About one fifth (19.2%) of the participant's choice for processed foods selection was price (Mahgoub et. al, 2007). A study carried out among 150 adolescent girls in Vadodara, Gujarat revealed that the most frequent factor considered by the participants for processed food purchase was brand name (49%), followed by taste (29%), food labeling (14%) and price (6%)(Chandorkar and Shah, 2014). Therefore, majority of the studies reported non-nutritional factors such as brand name and taste as the most common determinants of processed packaged food purchase by the consumers.

Figure 4.4.3: Nutritional Factors considered by the Consumers while Purchasing Processed Packaged Foods (in percentage)

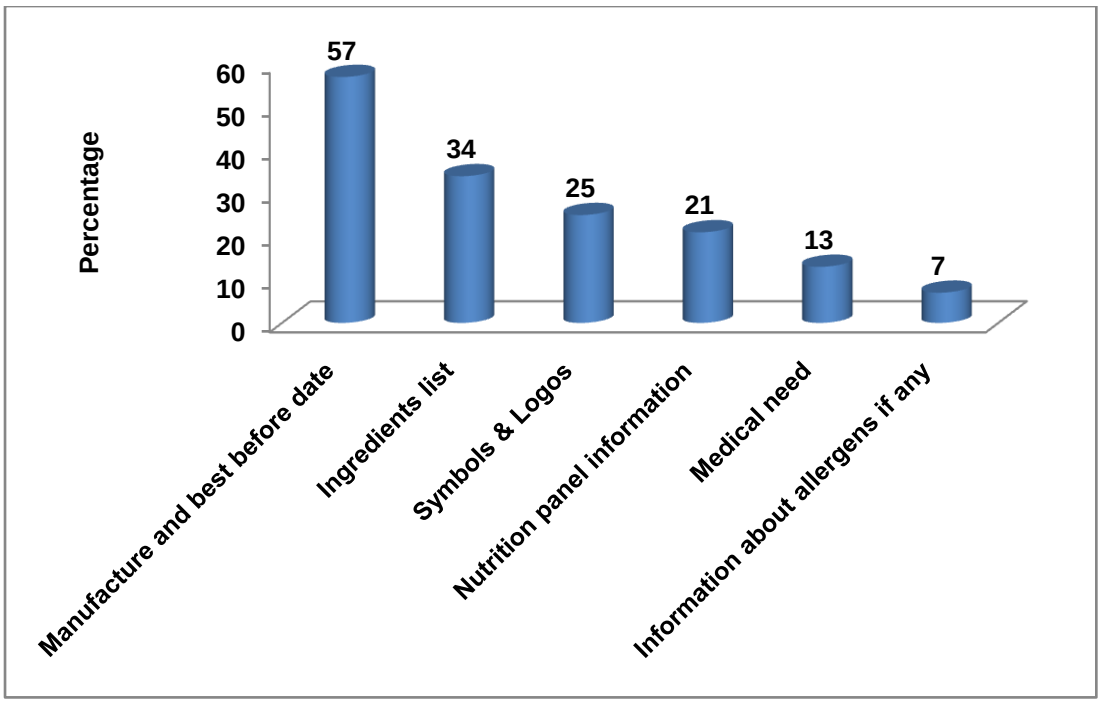


Table 4.4.3: Nutritional Factors Considered by the Consumers while Purchasing Processed Packaged Foods- Gender and Age-group wise (in percentage)

Nutritional Factors	Gender and Age-Groups					
	Adolescent Boys (n=135)	Adolescent Girls (n=212)	Adult Males (n=99)	Adult Females (n=210)	Elderly Males (n=76)	Elderly Females (n=75)
Manufacture and best before date	11	15	5	17	4	4
Ingredients list	5	7	4	11	4	3
Symbols and Logos	6	6	3	7	1	1
Nutrition Facts Panel (NFP)	4	4	3	7	2	2
Medical need	3	3	1	3	1	2
Information about allergens	2	2	0	1	0	1

In order to examine the consistency in consumer behavior towards processed packaged food purchase they were asked about purchasing behavior with respect to processed packaged food items. The objective was to analyze the attention paid by consumers to various categories of information on food label while purchasing processed packaged foods. The results presented in Figure 4.4.3, show that the information perceived as important by consumers does not often form the basis for purchasing the food product. The most commonly considered nutritional factors for purchase of processed foods were “manufacture and best before date” (57%), “ingredients list” (34%), “symbols and logos” (25%), NFP (21%), medical need (13%) and allergens (7%). Differences between genders were non-significant. At glance information like manufacture and best before date (26%), symbols and logos (12%) and allergen information (4%) were looked up more by adolescents while detailed information namely, ingredients list (14%) and NFP (9%) were looked up by adults. Similar results were observed in a cross-sectional study conducted in two metro cities (New Delhi and Hyderabad) in India. It was found that majority of the consumers (81%) looked only for the manufacturing date or expiry/best before date which was followed by nutrition information panel and ingredients list (33%). It was highlighted that nutrient information on the labels was not so often read by the consumers as they either lacked in nutrition knowledge or found the information too technical to understand (Vemula et. al, 2013). Another cross-sectional study in India among adolescents revealed that the most important information read by them were date of manufacture (79%), expiry date (74%) or best used before dates (65%). As compared to manufacture and best before date, fewer adolescents read ingredients

list (50%) and nutrition information (20%). About 66% believed that nutrition information on labels was too complex to understand (Saha et. al, 2013). A study carried out in Vadodara on 100 participants to assess their knowledge, use and comprehension regarding processed food consumption revealed that except for manufacture and best before date (63%) other nutritional factors namely, nutritive value (3%), medical need (4%), ingredients (5%), quality symbols (5%) and nutrition facts panel (3%) were not given much importance when it came to decision making for processed food purchase, while the non-nutritional factors like brand (81%), taste (63%), price (53%), recommendation (19%), product popularity (15%) and advertisements (15%) played an important role (Chandorkar and Joshi, 2012).

A study by Kumar and Ali (2011a) reported that 46% of the consumers always checked the list of ingredients in the food items they purchased while 34% of the consumers always checked nutrition panel information. Brand of the food product was the single most important criteria for the 42% respondents. Taste and price of the food product were other attributes in order of importance assigned by the respondents. Peer pressure and availability of such products were the least important reasons for buying them. These results indicate that if consumers are loyal to the brand and like the taste of a processed packaged food product, they buy it in spite of its inferior nutritional quality.

Various factors associated with the selection of processed foods by US consumers (n=1000) were NFP (68%), expiry date (63%), brand (50%), ingredients list (49%), product size (48%), cooking instruction (33%), nutrition claims (31%), health claims (24%), net weight (24%), symbols and logos (16%) and allergy information (14%) (IFIC, 2011). Study conducted in UAE showed that the majority of the consumers (85.6%) utilized information on expiry dates, followed by production dates (70.3%). The package size was found to be the least important, followed by instructions for preparation (Washi, 2012). Similar trends were observed in a study carried out in US. Older consumers were more likely to be influenced by healthfulness and sustainability and less likely to be influenced by price and convenience than the younger counterparts. Women were more likely than men to be influenced by price, healthfulness and sustainability (IFIC, 2013). An investigation from Ghana among 403 adult consumers showed a relatively better picture of consumer practices regarding processed food selection. The first four components of food labels considered by the consumers were nutritional factors namely, expiry date (26.9%), nutrition label information (19.6%), list of ingredients (11.8%) and manufacture date

(10%). Beside these, the other determinants for processed food purchase reported by them were, brand name (8.7%), country of origin (8%), nutrition/health claims (5.8%), description of food (5.1%), and additives (4.1%) (Aryee, 2013). All the studies from India revealed that consumers either place more importance to non-nutritional factors or at glance information rather than nutritional factors and detailed information. However, in developed countries like US consumers also pay attention to detailed information on food packages. The possible differences are due to increased awareness amongst consumers from developed countries due to various initiatives towards user friendly food labeling taken by them like "healthy choices program", "facts up front" and "pick the tick" (details mentioned in the review of literature chapter). In India, no such programs are initiated in the area of creating consumer awareness and user friendly nutrition labeling except for a few jingles that do it voluntarily.

Table 4.4.4: Practice of Reading Food Labels among Consumers- Gender and Age-group wise (in percentage)

Gender and Age-Groups	Frequency	Percentage
Adolescent Boys (n=135)	122	19
Adolescent Girls (n=212)	206	32
Adult Males (n=99)	63	10
Adult Females (n=210)	163	26
Elderly Males (n=76)	39	6
Elderly Females (n=75)	41	6

Of the total consumers (n=807), 634 consumers looked for food labels. As is evident from the table 4.4.4, of the 634 consumers that looked for food labels, 64% were females and 35% were males. In all age-groups a higher percentage of females reported looking at the food labels than males. However, 51% of the adolescents reported reading food labels, followed by adults (36%) and elderly (12%). Various studied have reported that more females read food labels than their male counterparts (Chandorkar and Joshi, 2012; Godwin et. al., 2006) Studies conducted in other regions of India namely, Kolkata, New Delhi and Hyderabad showed that self-reported behavior of consumers towards reading food labels were higher. It was found that 88% adolescents and 90% supermarket shoppers practiced food labeling (Saha et. al, 2013; Vemula et. al, 2013). A study conducted in UAE revealed that about 89.5% of the consumers use food labels (Washi, 2012). A cross sectional survey among 403 adult shoppers from Ghana revealed that only 22% adult

shoppers frequently use food labels, majority of the shoppers (53%) used labels "sometimes" while 25% shoppers never used food labels (Aryee, 2013). Therefore, findings by various authors revealed that females and adolescents read food labels more often than their counterparts. This indicates women's consciousness towards healthier foods.

Figure 4.4.4: Reasons for Examining Food Labels by the Consumers (in percentage)

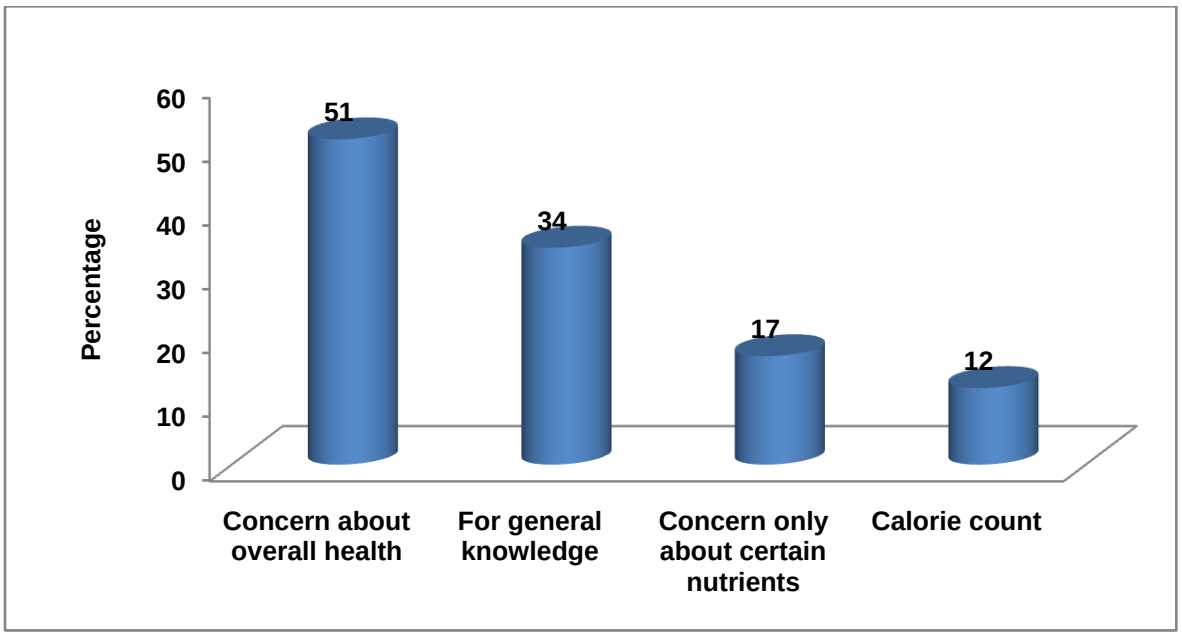


Table 4.4.5: Reasons for Examining Food Labels by the Consumers- Gender and Age-group wise (in percentage)

Gender and Age-Groups	For general knowledge	Concern about overall health	Concern only about certain nutrients	Calorie count
Adolescent Boys (n=135)	9	9	3	2
Adolescent Girls (n=212)	12	16	3	4
Adult Males (n=99)	2	6	3	1
Adult Females (n=210)	7	14	4	5
Elderly Males (n=76)	2	4	1	0
Elderly Females (n=75)	1	2	3	0

As is evident from Figure 4.4.4, consumers examined food labels due to the "concern about overall health" (51%), followed by "general knowledge" (34%), "concern about certain nutrients" (17%) and "calorie count" (12%). Similar findings were observed in a study by Chandorkar and Joshi (2012), wherein the most common reasons

reported for examining the nutrition labels were overall health concern (24%), general knowledge (13%) and concern about calorie intake (10%).

From the Table 4.4.5 it can be seen that females were more concerned about overall health (32%), read food labels for general knowledge (20%), track specific nutrients (10%) and pay attention to calorie count (9%) as compared to males. Adolescents examined food labels for overall health (25%) and for general knowledge (21%) however, more adults were concerned only about "certain nutrients" (7%) as compared to adolescents and elderly. The reason for same could be familiarity with "calories from food" and its association with health and increased awareness regarding health. Elderly were more concerned about overall health (6%) associated with the medical conditions affecting them. Majority of the adolescents preferred examining food labels keeping in mind overall health (Boys=9%, Girls=16%) and general knowledge (Boys=9%, Girls=12%) and not just "calorie count" and "certain nutrients."

Figure 4.4.5: Reasons for not Examining Food Labels by the Consumers (in percentage)

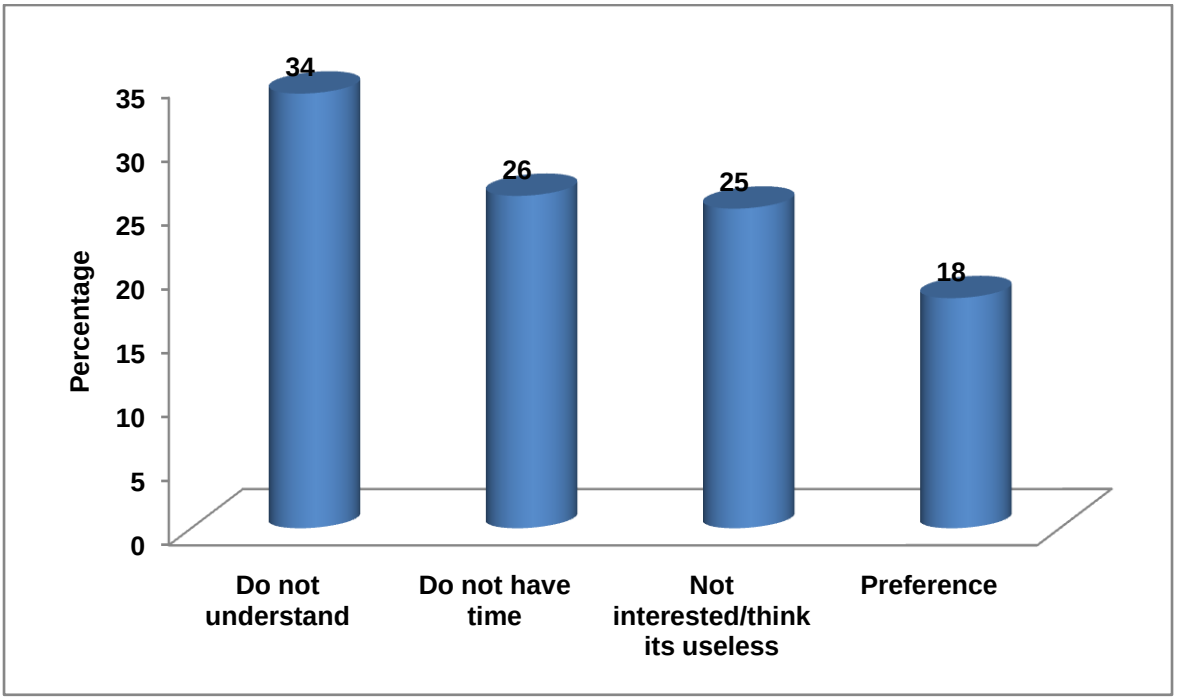


Table 4.4.6: Reasons for not Examining Food Labels-Gender and Age-group wise (in percentage)

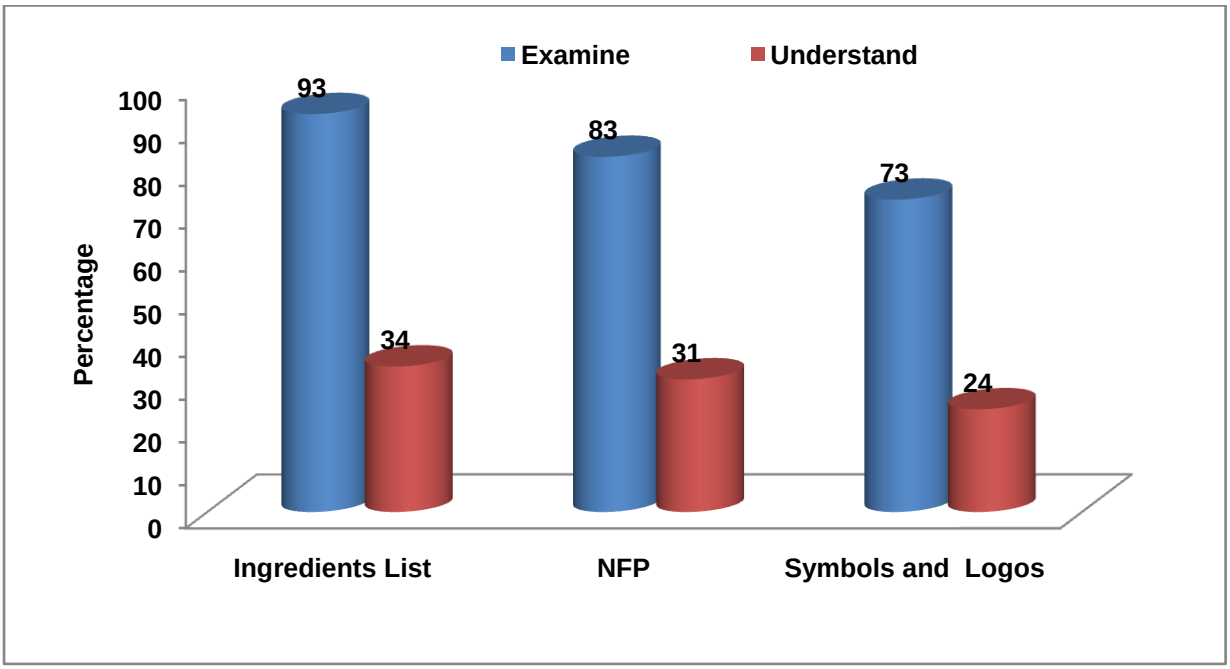
Gender and Age-Groups	Not interested/think its useless	Preference	Do not understand	Do not have time
Adolescent Boys (n=135)	4	1	2	1
Adolescent Girls (n=212)	3	1	0	0
Adult Males (n=99)	5	7	5	5
Adult Females (n=210)	9	9	6	10
Elderly Males (n=76)	1	1	12	3
Elderly Females (n=75)	3	0	10	6

Of the total participants, 21.4% (n=173) reported various reasons for not reading food labels. Figure 4.4.5 elicits the most frequently quoted reasons for not examining food labels. Thirty four percent of the consumers did not examine food labels as they “do not understand”, followed by “do not have time” (26%), not interested (25%) and preference for specific brand (18%). Chandorkar and Joshi (2012) reported similar reasons for not examining food labels by the consumers. The reasons reported were nutrition labels did not influence the subject’s foods selection (47%), disinterest in examining food labels (15%) and lack of understanding of nutirition labels (9%).

Gender and age differences from the Table 4.4.6 showed that a higher percentage of females were not interested in reading labels (15%) as compared to males (10%) and the reasons cited were “do not have time to read” food labels (16%), “do not understand” (16%) and “preferences” for specific brands (10%). However, inability to understand food labels was cited mostly by elderly females (10%) and lack of time was cited by adult females (10%). Males did not read food labels as they “do not understand” (19%) them. Age-group wise, 14% of the adults reported not reading food labels as “they are not interested”. Most adults went by “preferences” for specific brands (16%) and quoted “do not have time” (15%) to read food labels. Elderly consumers did not read food labels as they “do not understand” food labeling (22%). A cross-sectional study on consumer knowledge and use of food labels among 1,832 supermarket shoppers in India showed a positive association between education level and checking various aspects of food labels (Vemula et. al, 2013). Another study showed that brand loyalty, lack of time, price, uncertainity about accuracy of information, technical terms and confusion by too much information were the few reasons for not reading food labels by the consumers (Cowburn and Stockley, 2005; FSAI, 2009). Studies have also highlighted that food labels are not read for products

which are used on regular basis namely, milk, pasta, juices and pre-packaged fruit and vegetables. Junk foods, which everyone knows are unhealthy, are not looked for food labels as well. Food labels are read only by those who do household shopping (FSAI, 2009; Grunert and Wills, 2007).

Figure 4.4.6: Examining and Understanding the Use of Three Major Components of Food Labels by the Consumers (in percentage)



There are three major components on food labels namely, Ingredients list, Nutrition facts Panel (NFP) and Symbols and Logos that provide information about the packaged food. These three components together reflect the quality and suitability of the food product for consumption by the consumer. Figure 4.4.6 presents the percentage of consumers examining and understanding the use of the three major components of food labels. Of the three major sources of information, majority of the consumers (93%) used ingredients list for product information followed by NFP (83%) and symbols and logos (73%). However, the understanding about the use of the same ranged between 24% to 34% for each component.

Table 4.4.7: Examining and Understanding the Use of Three Major Components of Food Labels by the Consumers- Gender and Age-group wise (in percentage)

Gender and Age-Groups	Ingredients list		NFP		Symbols and Logos	
	Examined	Understood	Examined	Understood	Examined	Understood
Adolescent Boys (n=135)	18	5	16	5	16	5
Adolescent Girls (n=212)	31	10	28	8	27	7
Adult Males (n=99)	10	4	10	4	7	2
Adult Females (n=210)	24	11	21	11	18	8
Elderly Males (n=76)	5	1	4	1	2	0
Elderly Females (n=75)	5	2	4	1	3	2

Data presented in Table 4.4.7 reveal that females examined as well as understood the use food label information better than males. Of the various age-groups studied adolescent consumers looked for ingredients list (49%), NFP (44%) and symbols and logos (43%) more often than adults and elderly. Though adults examined the three components of food labels less often than adolescents yet equal percentage of adults had knowledge about the use the same. The understanding of ingredients list was high in adolescent and adults (15%) than elderly (3%). Understanding about the use of NFP was better among adults (15%) compared to adolescents (13%) and elderly (2%). Symbols and logos were better understood by adolescents (12%) than adults (10%) and elderly (2%). Several researchers have concluded that consumers either do not routinely use the nutrition information panel or are unable to correctly interpret it (Jones and Richardson, 2007; Ni-Mhurchu and Gorton, 2007). Thus, the results conclude that adolescents and adults are better informed than elderly consumers. The reason for better understanding of food labels among adolescents and adults could be the ability to read and understand the food labels in English. Absence of information in Hindi or local language (though mandated by FSSA) restricts the use of food labels by elderly consumers.

Figure 4.4.7: Information Looked on NFP during Processed Packaged Food Purchase by the Consumers (in percentage)

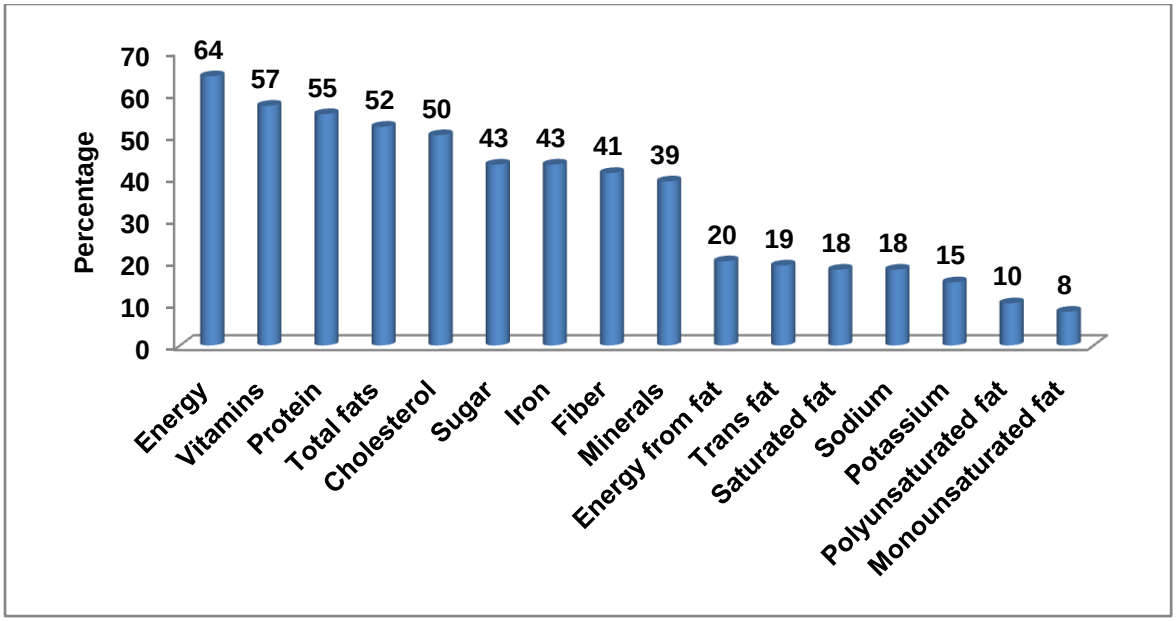


Figure 4.4.7 presents the most commonly examined nutrients on NFP by the consumers. Of the total population that reported reading food labels (n=634), 83% (n=527) read NFP. Sixty four percent of the consumers reported looking for energy values on NFP followed by vitamins (57%), protein (55%), total fats (52%), cholesterol (50%), sugar (43%), iron (43%) and fiber (41%). Other undesirable nutrients namely, calories from fat (20%), TFA (19%), SFA (18%), sodium (18%) were less often looked at for product selection. Similar findings were obtained in a study by Chandorkar and Joshi (2012) wherein the nutrients examined by the consumers were closely similar but with varying percentages. They were, energy (30%), total fat (27%), sugar (26%), cholesterol (25%), protein (18%), sodium (15%), fiber (14%), trans fat (8%), iron (4%), energy from fat (2%), saturated fat (2%), vitamins (2%), minerals (2%) and potassium (1%). Polyunsaturated fat and monounsaturated fat were the nutrients which were never examined by the subjects, however in the present study 10% and 8% of the consumers reported looking for PUFA and MUFA, repectively on NFP. Unlike the present study, a study on Americans showed that the first eight nutrients which were looked for were “nutrients of concern” namely, energy (68%), fat (67%), salt/sodium (61%), sugar (55%), SFA (53%), TFA (51%), cholesterol (46%) and calories from fat (46%). The subjects also looked for other nutrients like fiber (46%), carbohydrates (41%), vitamins and minerals (40%), protein (39%), calcium (26%) and potassium (19%) (IFIC, 2011).

Another study on American subjects revealed that most commonly observed nutrients on the nutritional panel was fat (51.1%), sugar (47.1%) and sodium content (41.3%) (Godwin et. al, 2006).It is to be noted that American subjects examine more of "nutrients of concern" as compared to the nutrients examined by the subjects in the present study. Such variations could be because of the differences in the level of awareness among Indian and American consumers.

Table 4.4.8: Information Looked on NFP during Processed Packaged Foods Purchase by the Consumers- Gender and Age-group wise (in percentage)

Gender and Age-Groups	Adolescent Boys (n=135)	Adolescent Girls (n=212)	Adult Males (n=99)	Adult Females (n=210)	Elderly Males (n=76)	Elderly Females (n=75)
Energy	14	19	8	16	3	5
Vitamins	13	21	6	16	1	0
Protein	12	19	7	14	2	1
Total fats	11	19	5	14	3	1
Cholesterol	9	18	4	13	3	2
Iron	9	15	4	12	3	1
Sugar	9	12	5	13	3	1
Fibre	6	10	6	12	4	3
Minerals	10	10	4	12	2	1
Energy from fat	6	6	2	6	1	0
Trans fat	5	7	1	6	0	0
Saturated fat	5	5	2	7	0	0
Sodium	3	4	2	4	2	2
Potassium	3	4	1	3	3	1
Polyunsaturated fat	3	3	1	4	0	0
Monounsaturated fat	2	3	0	3	0	0

Table 4.4.8 highlight that females were more concerned about each nutrient as compared to males and adolescents looked for nutrients more often than adults and elderly. However, adults were found to be looking more for fiber (18%) than adolescents (17%) and elderly (7%). Though, elderly did not report to look for majority of the nutrients but within elderly group, they mostly looked for energy and fibre (7% each). As compared to elderly females, more elderly males looked for various nutrients namely, fiber (4%), total fats, cholesterol, iron, sugar, potassium(3%

each), minerals and protein (2% each) and vitamins and energy from fat (1%). Studies revealed that most of the consumers look for calories, fat, sugar, salt, carbohydrates, vitamins and calcium on food labels (Grunert et. al, 2010). Women and girls were mostly concerned about 'fat' and 'sugar' intake (Vemula et. al, 2013).

Understanding of Symbol, Logos and NFPs by Consumers

The knowledge and comprehension skills of the consumers on seven types of symbols and logos namely, Vegetarian symbol, Non-vegetarian symbol, AGMARK, FPO, Healthy Choice, Smart choice and HACCP was assessed. Comprehension skills of the consumers on four different kinds of NFPs commonly found on Indian processed packaged foods were also assessed. The format and the amount of information presented on four NFPs were distinct from each other. NFP-1 presented the nutrients as “per 100 g” of the product. It reported the fractions of total fats and total carbohydrates. NFP-2 presented nutrients in two tabular formats. One table detailed micronutrients with their significance and second table listed four mandatory nutrients. The information was given as “per 100 g” of the product. NFP-3 reported nutrients as “per 100 g” and “per serving” of the product with all five mandatory nutrients listed in the table in addition to SFA, fiber and sodium. NFP-4 listed nutrients in two tables. One of the tables had nutrients as “per serving” and “%DV” with all the mandatory and other essential nutrients while the other table presented nutrients as “per 100g.” The NFPs are presented in Annexure IV, Part III. The aim of exposing consumers to these four kinds of NFPs was to assess the level of comprehension among consumers on each kind of NFP and to arrive at easy to understand NFP.

Table 4.4.9: Familiarity, Understanding and Use of Symbols and Logos present on Food Labels-Total Population (in percentage)

Symbols and Logos	Familiarity with the symbol/logo	Understanding of the symbol/logo	Use of symbol/logo as guiding tool
Smart Choices	23	2	11
AGMARK	52	19	35
Vegetarian	64	57	55
Non-vegetarian	59	54	51
FPO	35	4	18
Healthy Choice	29	6	17
HACCP	9	3	5

Table 4.4.9 illustrate that the most familiar and understood symbols and logos were vegetarian (64% and 57%) and non-vegetarian symbol (59% and 54%). The same were the major influencers among all symbols and logos during product purchase by the consumers. The understanding of vegetarian and non-vegetarian symbol was lower than its familiarity. The reason for low understanding and comparatively higher familiarity may be due to the over-reporting by the consumers. Similar results were observed in a study by Chandorkar and Joshi (2012), wherein the most commonly observed symbols were vegetarian logo (98%) and non-vegetarian logo (98%). However, none of the subjects could identify other quality symbols namely, FPO, Smart Choice, Healthy Choice, and HACCP except for AGMARK which was identified by 21% of the subjects. Comparatively, in the present study the familiarity among consumers towards other symbols namely, AGMARK (52%), FPO (35%), Healthy Choice (29%), Smart Choice (23%) and HACCP (9%) were reported to be average but the understanding about the same was below average. Other studies have also shown that 60% of the consumers read quality symbols (Vemula et. al, 2013). Similar study on adolescents showed that majority of the adolescents (60%) recognized the symbols but had no knowledge of what they indicated (Saha et. al, 2013). The results thus implicate that there is a need to provide education on different aspects of food labeling to promote label use and healthy product selection.

Table 4.4.10 indicates gender and age wise percentage of familiarity, understanding and use of symbols and logos. Results reflected that understanding and use of symbols and logos as a guiding tool for product selection was lower than the familiarity in both genders and all age-groups. The familiarity, understanding and use of the symbols and logos were higher in females and adolescents as compared to their counterparts.

A study by Vyth et. al. (2009), showed that those consumers who were more concerned about health were more likely to use logos on food labels for making food choices. Therefore, it can be concluded that the better the consumers are informed the healthier are their food choices.

Table 4.4.10: Familiarity, Understanding and Influence of Symbols and Logos present on Food Labels- Gender and Age-group wise (in percentage)

Gender and Age groups	Familiarity, Understanding and Use of Symbols and Logos	Smart Choices	AGMARK	Vegetarian	Non-vegetarian	Fruit Product Order	Healthy Choice	HACCP
Adolescent Boys	Familiarity with the Symbol/logo	5	11	14	13	8	7	2
	Understanding of the Symbol/logo	1	4	12	11	0	1	0
	Use of Symbol/logo as guiding tool	3	8	12	11	4	4	0
Adolescent Girls	Familiarity with the Symbol/logo	9	18	22	21	10	11	3
	Understanding of the Symbol/logo	1	6	20	19	1	2	0
	Use of Symbol/logo as guiding tool	5	14	20	18	6	7	2
Adult Males	Familiarity with the Symbol/logo	2	5	6	6	4	2	0
	Understanding of the Symbol/logo	0	3	6	5	0	0	0
	Use of Symbol/logo as guiding tool	0	3	5	5	2	1	0
Adult Females	Familiarity with the Symbol/logo	5	13	15	14	11	8	2
	Understanding of the Symbol/logo	0	5	14	14	1	1	1
	Use of Symbol/logo as guiding tool	1	7	13	13	5	3	1
Elderly Males	Familiarity with the Symbol/logo	1	2	2	2	1	0	0
	Understanding of the Symbol/logo	0	1	2	2	0	0	0
	Use of Symbol/logo as guiding tool	0	1	2	2	0	0	0
Elderly Females	Familiarity with the Symbol/logo	2	3	3	3	2	2	1
	Understanding of the Symbol/logo	0	0	3	3	1	1	1
	Use of Symbol/logo as guiding tool	1	2	3	3	2	1	1

Similar study by Graham and Jeffery (2011), showed that the self reported estimates of food label usage by the consumers were higher than the actual usage. The study measured the actual viewing of NFP by using eye-tracking technology and found that only 9% of 203 adult participants viewed the NFP “calorie” content as compared to their self-reported responses which were 33%. Similarly, 31% of the consumers reported of looking at the total fat content on NFP, but actually only 1% looked for the

same. Thus, it can be concluded that triangulation technique or eye-tracking technique or similar techniques are required to get the actual estimates of label usage by the consumers.

Figure 4.4.8: Comprehension of Four Kinds of NFPs by the Consumers (in percentage)

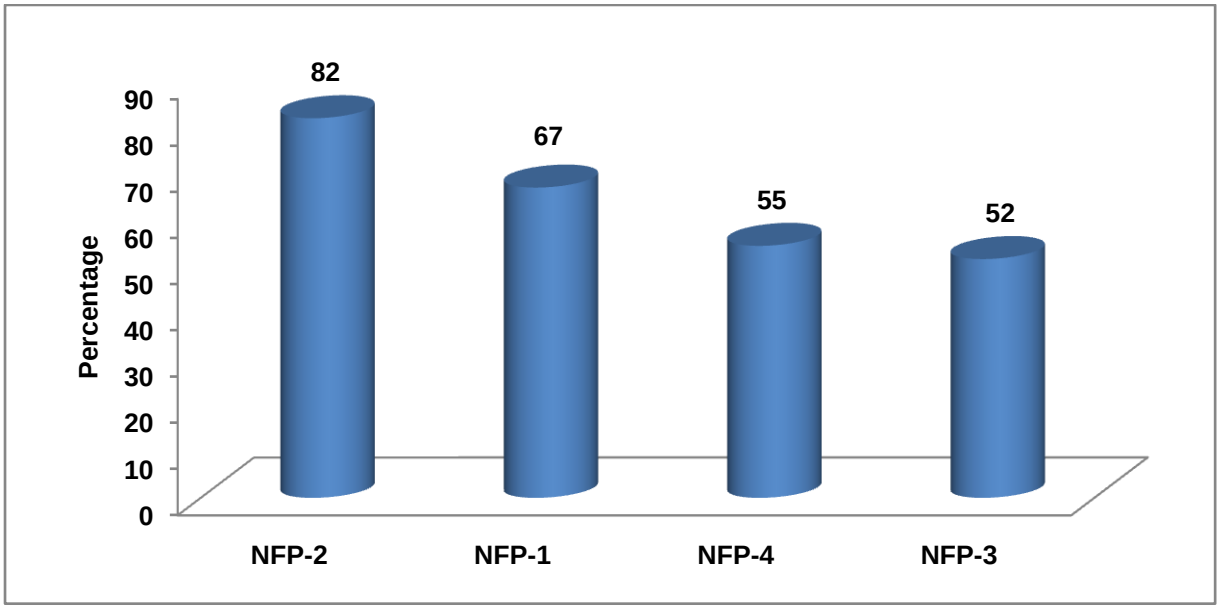


Table 4.4.11: Comprehension of Four Kinds of NFPs by the Consumers- Gender and Age- group wise (in percentage)

Gender and Age-Groups	NFP 1	NFP 2	NFP 3	NFP 4
Adolescent Boys	14	16	11	12
Adolescent Girls	25	32	23	24
Adult Males	7	8	5	4
Adult Females	18	19	12	14
Elderly Males	2	3	1	0
Elderly Females	2	4	0	0

As is evident from the Figure 4.4.8, the best comprehended NFP was NFP-2 and it was understood by 82% of the consumers. NFP-1 was understood by 67% of the consumers followed by understanding of NFP-4 (55%) and NFP-3 (52%). It is interesting to note that the understanding of each NFP was above 50%. It can be seen from Table 4.4.11, each NFP was better understood by adolescents, followed

by adults and elderly. In each age-group, understanding of NFPs was better in females than males.

Figure 4.4.9: Percent Knowledge Scores of Consumers on Food Labeling (in percentage)

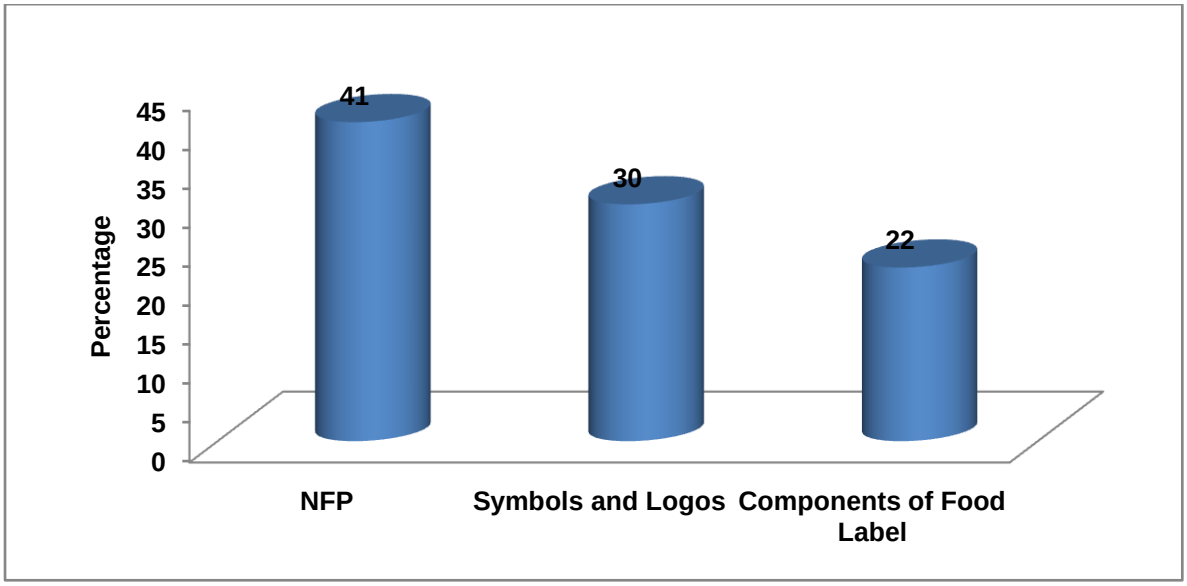


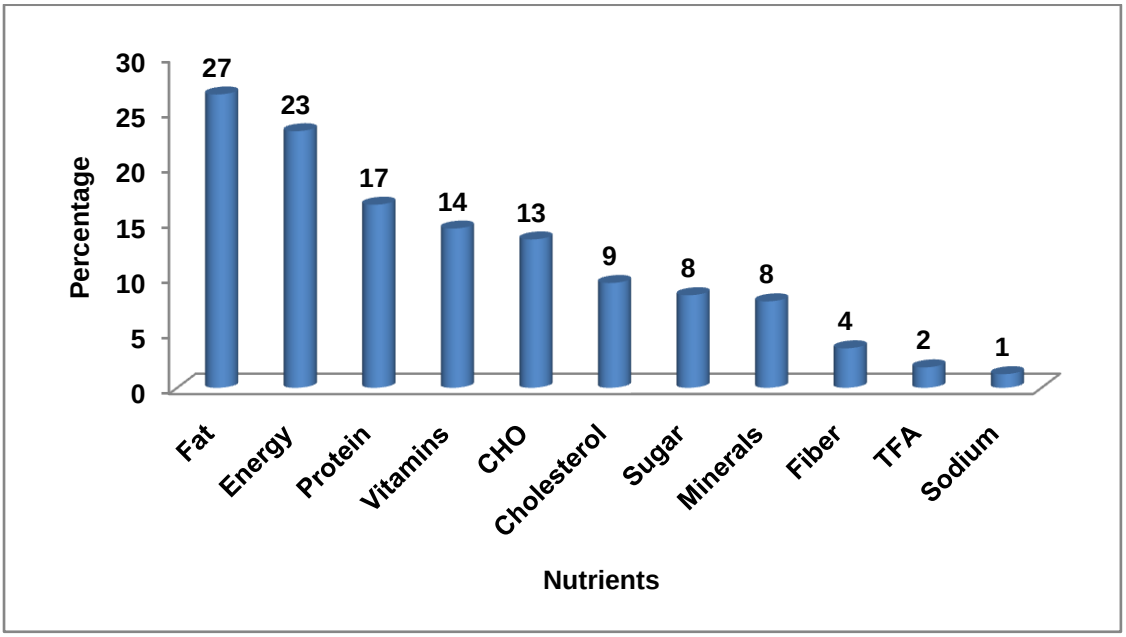
Table 4.4.12: Percent Knowledge Scores of Consumers on Food Labeling- Gender and Age-group wise (in percentage)

Gender and Age-Groups	NFP	Symbols and Logos	Components of Food Label
Adolescent Boys	50	28	20
Adolescent Girls	53	30	20
Adult Male	45	26	23
Adult Female	53	30	31
Elderly Male	25	23	14
Elderly Female	20	46	24

Figure 4.4.9 show the percent scores achieved by consumers on understanding of NFPs, Symbols and Logos and Components of food label (usage of ingredients list, NFP and symbols and logos). It was observed that percent knowledge scores achieved by the consumers were more for NFPs (41%) as compared to symbols and logos (30%) and other components of food labels. As indicated in the Table 4.4.12

the understanding of NFPs was better among adolescent girls (53%) and adult females (53%) than their male counterparts. However, elderly females scored less (20%) than elderly males (25%) on NFP understanding. Symbols and logos and components of food labels were better understood by females of all age groups. Age-group wise, NFP understanding was highest among adolescents, while symbols were better understood by elderly and components of food label were understood by adults. Therefore, at a glance information was better comprehended by elderly group and the reason could be that symbols and logos symbolically represent the quality of the product and in-depth nutrition knowledge is not required for their interpretation.

Figure 4.4.10: Nutrients Considered by the Consumers while Evaluating Four Kinds of NFPs (in percentage)



As illustrated in Figure 4.4.10, fat was considered by most of the consumers (27%) for evaluating NFPs, followed by energy (23%), protein (17%), vitamins (14%) and carbohydrates (13%). The picture here is disappointing in the sense that the "nutrients of concern" namely, cholesterol, sugar, TFA and sodium were considered by less than 10% of the consumers. Thus, the results indicate low consumer awareness for various nutrients among consumers.

Figure 4.4.11: Difficult to Understand NFPs Reported by the Consumers (in percentage)

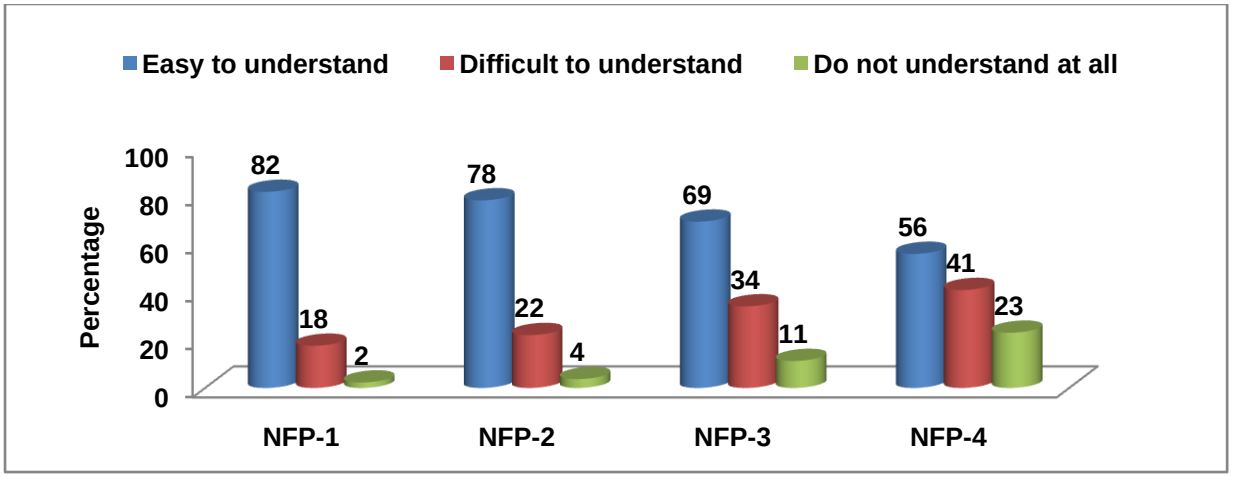


Figure 4.4.11 show the self reported behavior of the consumers about the difficulty in understanding the NFPs. Of the four different NFPs presented to the consumers, NFP-1 was reported to be the least difficult to understand by 82% of the consumers. NFP-1 was followed by NFP-2 (78%), NFP-3 (69%) and NFP-4 (56%). It is worth mentioning here that as the complexity or the amount of information on NFPs increased, the difficultly in comprehension also increased. Therefore, is a need to present NFPs in simplified format so as to make them easy to understand.

Figure 4.4.12: Terminologies Difficult to Understand on NFP as Reported by the Consumers (in percentage)

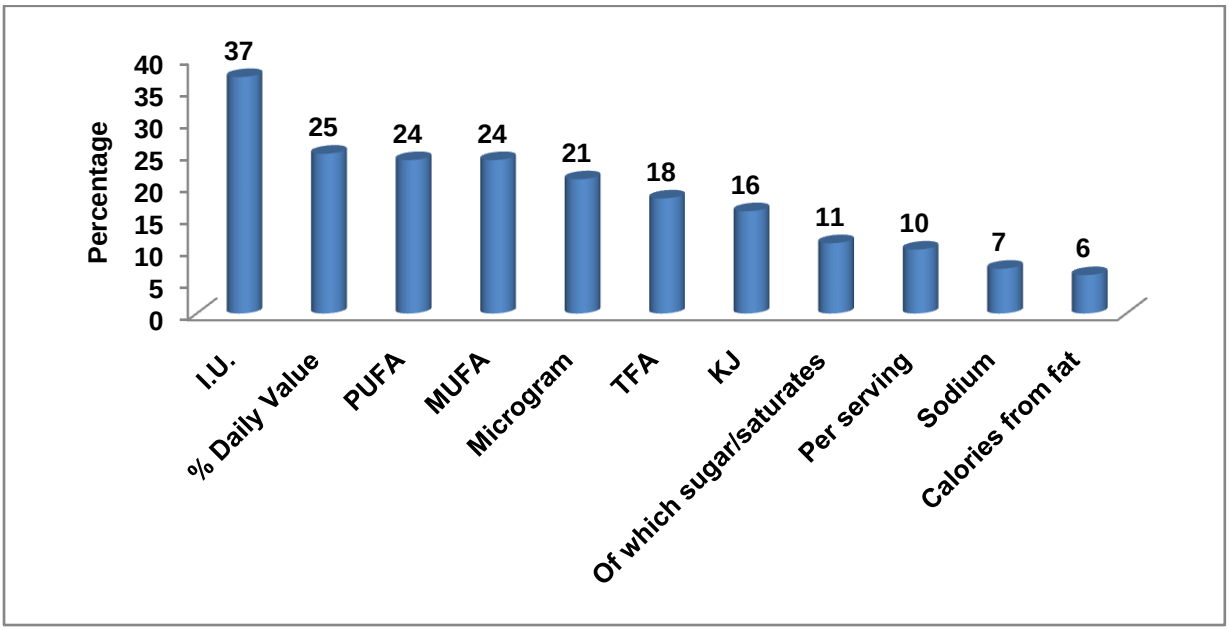


Table 4.4.13: Terminologies Difficult to Understand on NFP as Reported by the Consumers- Gender and Age-Group wise (in percentage)

Terminologies	Adolescent Boys	Adolescent Girls	Adult Males	Adult Females	Elderly Males	Elderly Females
% Daily Value	7	9	3	4	2	0
I.U.	9	14	4	8	2	1
Microgram	5	8	2	6	1	0
Of which sugar/saturates	2	2	2	2	2	1
KJ	1	5	1	4	1	2
Per serving	3	3	1	2	0	0
PUFA	6	7	3	5	1	1
MUFA	6	7	3	6	1	1
TFA	5	3	3	5	1	1
Calories from fat	1	1	0	1	1	0
Sodium	1	2	1	1	1	0

Figure 4.4.12 delineates the terminologies that consumers found difficult to understand on the given NFPs. “International Unit” (37%) often abbreviated as I.U. on NFPs was the least understood terminology among consumers which was followed by “% Daily Value” (25%), PUFA (24%), MUFA (24%), microgram (usually symbolized as µg) (21%), TFA (18%), KJ (Kilo Joule) (16%), of which sugars/saturates (11%), per serving (10%), sodium (7%) and calories from fat (6%). Similar investigation conducted by Chandorkar and Joshi (2012) revealed that 94% of the subjects did not understand the terms like MUFA and PUFA followed by ‘I.U’ (88%), ‘KJ’ (65%), ‘of which sugars/saturates’ (62%), ‘% Daily Values’ (61%) and ‘trans fats’ (52%). Less than half of the subjects did not understand ‘µg’ (43%), ‘calories from fat’ (42%), ‘per serving’ (24%) and ‘sodium’ (16%). Though the terminologies that were reported difficult to understand were nearly same in the present study and study by Chandorkar and Joshi, yet the magnitude of understanding for each term varied in both the studies.

Table 4.4.13 show gender and age-group differences towards understanding of terminologies on NFP. Gender differences revealed that females had greater difficulty than males in understanding of terminologies on NFP. Twenty three percent females reported to have difficulty in understanding “I.U.” followed by “µg” (14%), PUFA (14%), MUFA (14%),“% Daily Value” (13%), KJ (12%) and sodium (4%). Age-group variations showed that difficulty in understanding of majority of the terminologies on NFP were higher among adolescents as compared to adults and elderly. As these responses were self-reported the actual percentages could be

different. Comparable results were obtained from a qualitative study in US wherein "% Daily Value" confused the consumers (Borra, 2006). Studies have shown that consumers experience difficulties with understanding the nutritional information on the food labels chiefly due to the complex terminologies that are used in presenting nutrition information (Cowburn and Stockley, 2005; Peters-Texeira and Badrie, 2005)

Sub-phase IV (b): Development of Intervention Tools and Capacity Building of Consumers

As mentioned in methods and materials chapter, two Nutrition Health Education (NHE) material namely, 1x1 meter colored poster on "A B C of Food Labels" and a 15-page colored, pictorial booklet on "How to Read Nutrition Labels: A Step Wise Guide" (Annexure V and VI) were developed to carry out the intervention among 230 adolescents (aged 15-19 years) from "Phase I- Situational Analysis: Processed Food consumption among consumers."

An interactive session of one hour was carried out among adolescents on food labeling. Various aspects of food labeling namely, FOP labeling, BOP labeling, symbols and logos, nutrition and health claims, ingredients list, NFP, allergy declaration, manufacture and best before date, batch number, etc. were discussed. The post-intervention results have been presented and discussed in sub-phase IV (c) i.e. Impact Evaluation after Intervention.

Sub-phase IV (c): Impact Evaluation after Intervention

Based on the intervention among 230 adolescent consumers, post intervention session was conducted among consumers regarding the understanding of various aspects of food labels. Post intervention two experimental food labels namely, Label 1 and Label 2 were administered (Annexure VIII(a) and VIII(b)) to adolescent consumers. The NFPs in the experimental food labels were similar to the most commonly found NFPs on the processed food products surveyed in "Phase II- Market Survey" and of the four used in pre-intervention survey i.e. "Phase IV- Consumer awareness and practices survey." The food labels carried basic components (mandatory and voluntary) of nutrition labeling like symbols, logos, health claims, nutrition claims, allergen information, Information about preservatives, information

about colors and flavors, ingredients list and NFPs. However, the labels were distinct from each other in the way of presentation of nutrition information. The detailed components of nutrition labeling in each of the experimental food label are given in the Table 4.4.14

Table 4.4.14: Differences between Experimental Food Labels

Components of Nutrition labeling	Experimental Food Label 1	Experimental Food Label 2
Nutrition and Quality Symbols	Smart Choice ISO	FPO HACCP
Logos	Vegetarian Logo	Non-Vegetarian Logo
Health Claims	Heart Friendly	_
Nutrient Claims	Zero Cholesterol Zero Trans Fat Low Sodium No MSG No Preservatives	No added MSG No added Preservatives
Allergen Information	Product Contain Nuts	May Contain Traces of Soya and Nuts
Information about Preservatives	_	_
Information about Colors and Flavors	_	Contains Permitted Natural Color 100(I) and added Flavor-Nature Identical Flavoring Substances
Ingredients List	• Constituents in Ingredients list were in descending order of percentage weight • Harmful ingredients (salt/sodium, sugar, fat) were not in large quantities • No more than one source of harmful ingredients (salt, sugar, fat) was present.	• Constituents in Ingredients list were not presented in percentage weight. • Harmful ingredients (salt/sodium and fat) were in large quantities • More than one source of harmful ingredients namely sodium (salt, sodium citrate, yeast Extract and Hydrolyzed vegetable protein and fat (edible vegetable fat and butter) were present.
Nutrition Facts Panel	Per 100 g and Per Serving	Per serving and % Daily Value

The purpose of experimental food labels was to assess the post intervention knowledge of the consumers by giving them a situation close to the reality of purchasing a food product by assessing its nutrition quality. Another aim of presenting the food labels to the consumers was to find the grey areas of nutrition

labeling that were less understood or poorly comprehended post intervention, based on the scores achieved by the consumers. This would help in further improvement of the strategies to be adopted regarding consumer education and presentation of nutrition information on food labels.

Understanding of Label 1 and Label 2 among Adolescents

Table 4.4.15: Post Intervention Scores of Adolescents on Food Label Comprehension (Label 1 and Label 2) (percent scores)

Experimental Labels	Total Population (% scores)	Boys (%scores)	Girls (% scores)
Label 1 (Out of 26)	54	46	58
Label 2 (Out of 30)	37	30	43

Table 4.4.15 displays the overall percent scores on the understanding of two experimental food labels. It was found that Label 1 (54%) was better understood as compared to Label 2 (37%). Understanding of Label 1 (boys=46% and girls=58%) was better than Label 2 (boys=30% and girls=43%) in both the genders, however girls scored better in understanding of both the food labels as compared to boys. The reason for better understanding of Label 1 could be because it followed the principles of labeling ingredients list and the NFP was in per 100g and per serving. Such NFP is most commonly found on processed packaged foods in India and therefore, familiarity with the same resulted in better comprehension.

Figure 4.4.13: Understanding of various Components of Food Labels in Label 1 and Label 2 among Adolescents Post Intervention (percent scores)

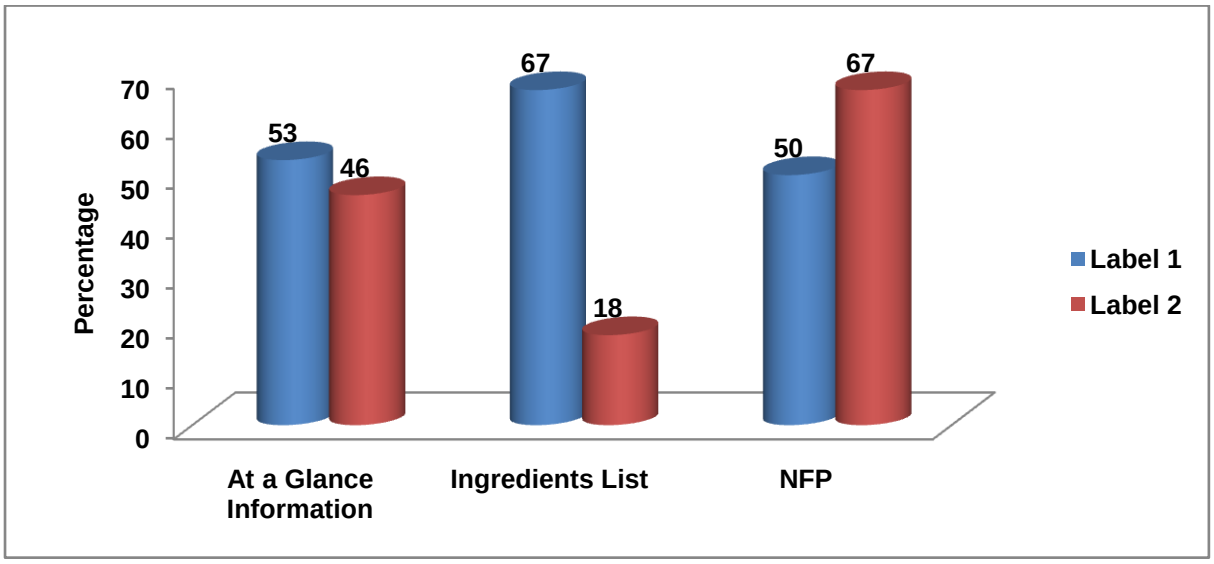


Table 4.4.16: Understanding of various Components of Food Labels in Label 1 and Label 2 among Adolescent Boys and Girls Post Intervention (percent scores)

Genders	Experimental Labels	At a Glance Information (Out of 17)	Ingredients List (Out of 3)	NFP (Out of 6)
Boys	**Label 1**	41	67	50
	Label 2	38	9	50
Girls	**Label 1**	59	67	50
	Label 2	54	18	67

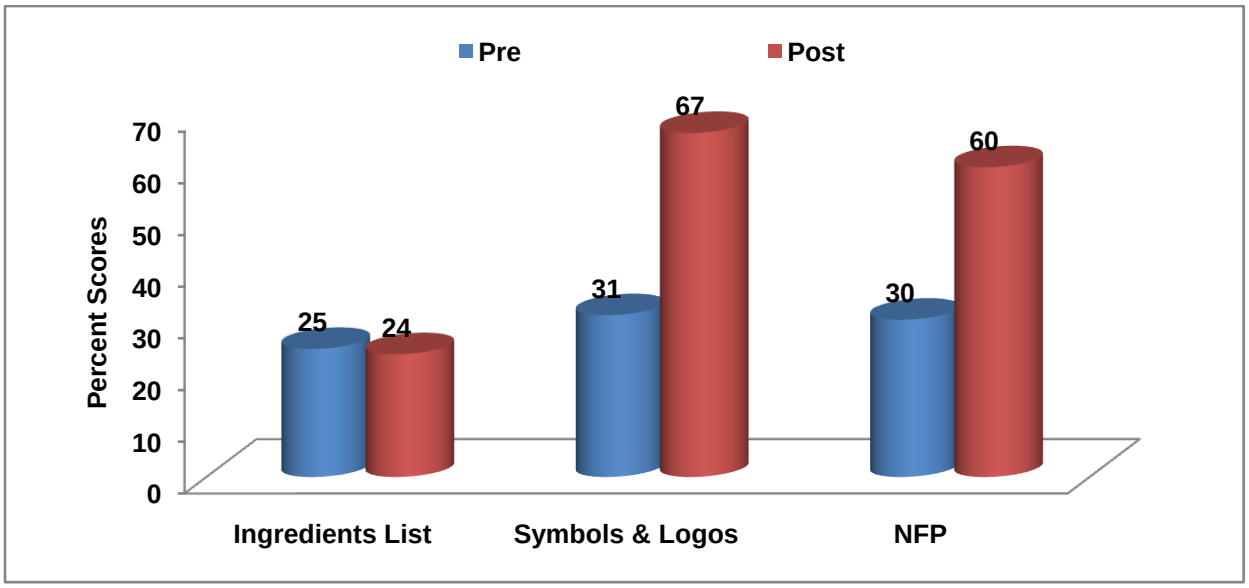
Data presented in Figure 4.4.13 and Table 4.4.16 detail the understanding of different sections of food labels among consumers. It was revealed that at glance information (i.e. symbols, logos, health and nutrient claims, allergen information, information about preservatives, information about colors and flavors) in Label 1 was better understood (53%) by girls than boys (Girls=59%, Boys=41%). The understanding of the same for Label 2 was lower in both the genders. The better understanding of "at a glance information" of Label 1 may be attributed to the placement of information (i.e. nutrient claims, health claim and symbols and logos in Label 1) at FOP while the same were placed at BOP in Label 2. Similarly, allergen information was appropriately highlighted in Label 1 as compared to Label 2 where it was somewhat merging with the information about colors and flavors and hence lost its effect.

Ingredients list of Label 1 was better understood by the whole population (67%) as well as by both the genders (67%). This may be attributed to the way of presentation of the same in both the labels. In Label 1 the ingredients list was placed in a box as well as the ingredients were in descending order of their percentage weight which gave a clear idea about the nutrition quality of the product. However, in Label 2, the ingredients list lacked in presenting the ingredients in descending order of their percentage weight.

NFP of Label 2 was better understood by the consumers as compared to the NFP of Label 1. The better understanding of NFP of Label 2 may be attributed to the fact that the nutrition information was presented in "per serving" and "% daily value" which is easy to relate and understand according to the thumb rule which states that harmful nutrients namely, fat, trans fat sugar and sodium should be less than 5% DV.

Hence, it can be concluded that if the claims are placed at FOP, allergen information is placed in bold letters, ingredients list is presented in descending order of percentage weight and NFP in "per serving and % DV", then it becomes easy for the consumers to comprehend food labels.

Figure 4.4.14: Understanding of Three Major Components of Food Labels among Adolescents-Pre and Post Intervention (percent scores)



As mentioned in "Chapter 3: Methods and Materials" adolescents were given two experimental Food Labels and their responses were quantified by giving a score of "one" for each correct answer. Figure 4.4.14 present the pre-intervention and post-intervention scores on the understanding of the three major components of food labels among consumers. It can be seen that post intervention scores for symbols and logos and NFP increased as high as 50%. The increased scores for symbols and logos were from 31% to 67% and for NFP 30% to 60%. However, post intervention scores did not improve for ingredients list. This can be attributed to the fact that comprehension skills for ingredients list needs an in-depth knowledge about the ingredients and their alternative sources/names as discussed in Phase-II, Table 4.2.6. The results suggest that capacity building of consumers to read and interpret food labels enhance their skills towards healthy food choices. Therefore, in order to increase awareness among consumers frequent education sessions needs to be delivered in order to achieve 100% understanding of food labels.

Table 4.4.17: Mean Knowledge Scores on Three Major Components of Food Labels among Adolescents

Components of Food Labels	Pre- Intervention Knowledge Scores	Post-Intervention Knowledge Scores	t-value
	Mean±SD	Mean±SD	
Ingredients List	0.25±0.39	0.24±0.14	0.383 ^{ns}
Symbols and Logos	0.31±0.16	0.59±0.30	13.074 ***
NFP	0.30±0.29	0.60±0.24	12.812 ***

**** significant at 0.001 level, ns-not significant*

Table 4.4.17 show the pre and post-intervention mean knowledge scores of the adolescent consumers on various components of food labels. Results showed that there was no significant difference in the pre and post intervention mean knowledge scores of ingredients list. Paired sample t-test revealed statistically significant difference in the pre and post intervention mean knowledge scores of symbols and logos (p≤0.001, t=13.074) and NFP (p≤0.001, t=12.812) was observed among adolescent consumers. Thus, the results implicate that nutrition intervention among consumers was effective as it improved their scores on various components of food labeling. There is also a need for constant and repeated awareness sessions on food labeling for consumers.

Figure 4.4.15: Increase in Awareness among Adolescent Consumers regarding Symbols and Logos

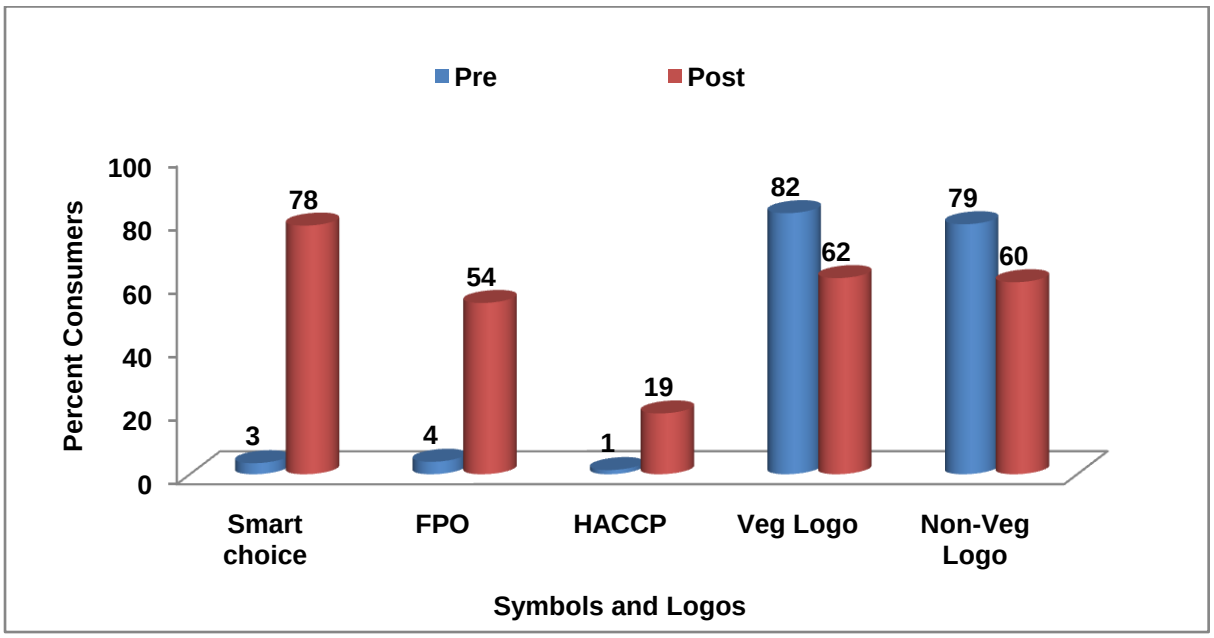


Figure 4.4.15 show the individual understanding of each symbol and logo after intervention. When identification of symbols and logos were assessed post intervention it was revealed that awareness about "smart choice", "FPO" and "HACCP" rose from 3% of the consumers to 78%, 4% to 54% and 1% to 19%, respectively. However, a reverse shift was seen with regard to vegetarian and non-vegetarian logo. Pre intervention, "vegetarian" logo was identified by 82% of the consumers and it declined to 62% after intervention. Similarly, "non-vegetarian" logo was identified by 79% of the consumers prior intervention and it slipped to 60% after intervention. The probable reason for this decline could be confusion among consumers when other symbols were also present on the food labels.

Figure 4.4.16: Increase in Awareness among Adolescent Consumers about Nutrient Claims

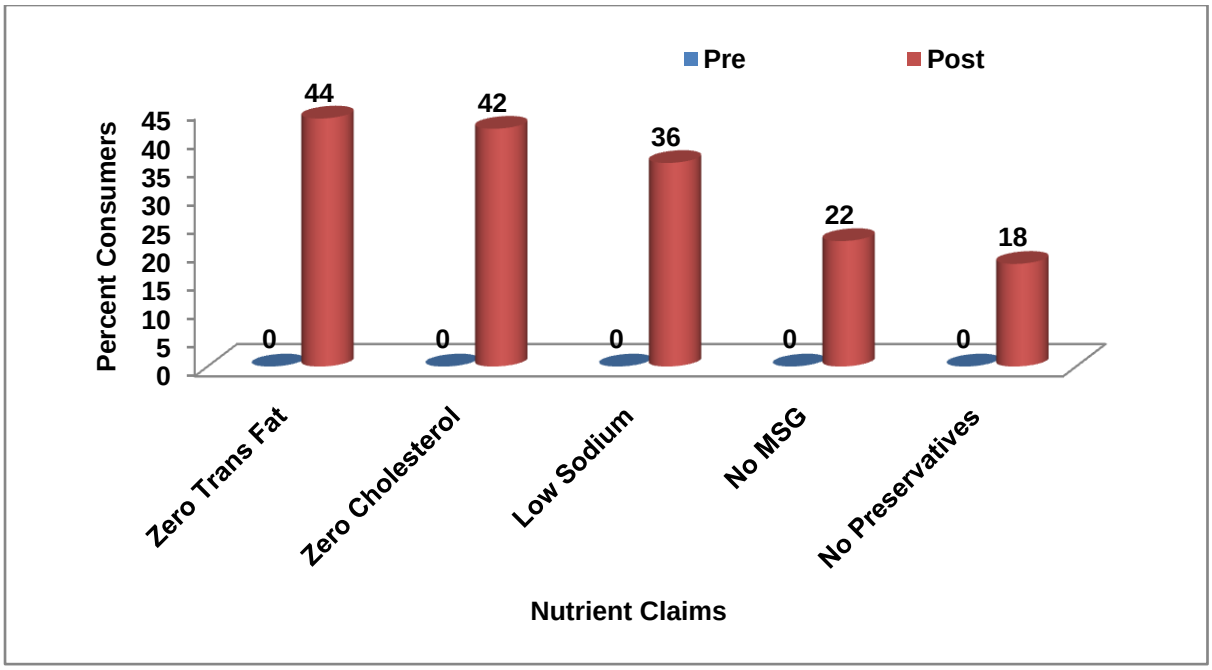


Figure 4.4.16 illustrates the ability of the consumers towards correct identification of nutrient claims. At baseline the knowledge about nutrient claims was assumed to be nil among consumers. An increase in awareness and identification of nutrient claims among consumers was observed post intervention session. It was seen that post intervention, "Zero Trans fat" claim was identified by 44% of the consumers followed by "zero cholesterol" claim by 42%, "low sodium" claim by 36%, "no MSG" claim by 22% and "no preservatives" claim by 18%. Therefore, it can be concluded that nutrient claim understanding increased appreciably after intervention.

Figure 4.4.17: Increase in Awareness among Adolescent Consumers about Health Claims, Information about Colors and Flavors and Allergen Information

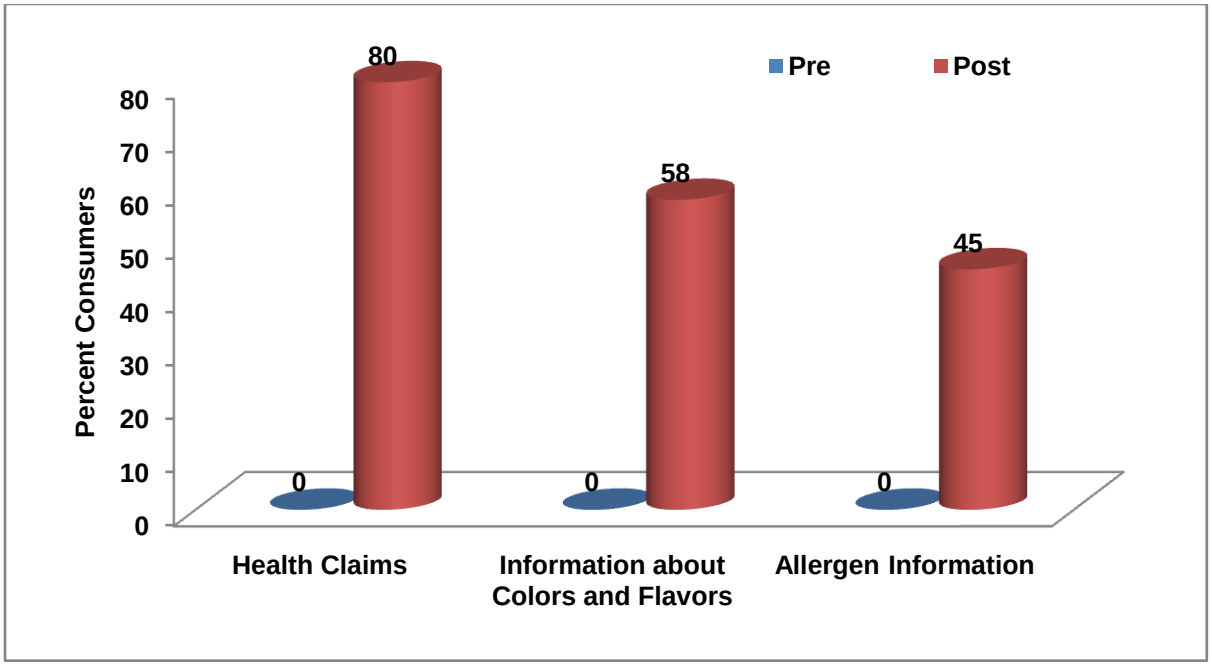


Figure 4.4.17 exhibit that health claims were understood by 80% of the consumers followed by 58% consumers understood information about colors and flavors and 45% understood allergen information. The awareness about these information were assumed to be nil at baseline. The limited research conducted on consumer use and understanding of nutrient and health claims has shown that consumers are more likely to purchase products featuring nutrient and health claims than those without (Roe et al, 1999).

Study conducted by Chandorkar and Joshi (2012) on awareness regarding quality symbols, nutrient and health claims, understanding the nutrition labels in terms of importance of various nutrients and their role in health also revealed an increase in awareness post education session. It was observed that nutritional factors namely, quality symbols, ingredients list, nutrition facts panel information, manufacture and best before dates, medical needs and allergen information that drive processed food selection were considered by the subjects post intervention. Therefore, nutrition awareness sessions positively effects consumer knowledge and understanding on food labeling. Education of population at large could be done by advertisements through various media, including a chapter on qulity symbols in schools/colleges etc. to improve consumer awareness and interpretation skills on food labels.