SUMMARY AND CONCLUSION

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The links between diet, nutrition and chronic diseases are well-established.There is a growing demand of processed foods in both high income Asian countries (Japan, Korea, Taiwan) and low income Asian countries like India.Lifestyle changes like urbanization, nuclear families, increasing number of working women, increasing disposable income, changes in taste/variety and less time for cooking are leading to increased demand of convenience foods. Such lifestyle changes are the major driving forces in the growth of processed food in India. Processed foods are characterized as energy dense, high in fat, high sodium/salt and sugar and low in fiber, vitamins and minerals. The unhealthy nutrient composition of processed foods is one of the leading causes of Diet Related Non-Communicable Diseases (DR-NCDs). Therefore, the increasing consumption of processed foods andthe resultant adverse health effects create a need for consumer awareness regarding healthy food selection from the wide range of processed foods available in the market. This can be achieved by knowing the importance and understanding of nutrition labeling on food packages. Nutrition labelingis a medium which helps the producers to communicate the nutritional properties of the food to the consumers. On one hand, it is a tool to promote and protect public health by providing nutritional information to the consumers while on the other hand it acts as an instrument of marketing and product promotion for the producers. To make use of the nutrition labels it is very important for the consumers to understand and comprehend the given information on the product label.The information on the label is given at the front-of-pack (FOP), back-of-pack (BOP) and/or side-of-pack (SOP) according to the kind of package. Therefore, the present study was carried out with the objective to study food labels, their compliance with Food Safety and Standards Act (FSSA) of India and Codex Standards, composition of processed packaged foods and to understand the consumer knowledge, attitude and practices towards consumption of the same.

The study was carried out in four phases. Phase-I of the study was formative research to study the processed packaged food consumption patterns across age, gender and professional groups among 807 consumers (aged ≥15 years) from free living population of Urban Vadodara. Phase II of the study was survey of the supermarkets (n=4) and grocery stores (n=4) to examine processed packaged foods (n=1,020) for various components of food labels namely, symbols and logos, nutrition and health claims, ingredients list, allergen information, NFP, information about

colors, flavors and preservatives, manufacture and best before date and other miscellaneous information. Phase-III of the study dealt with the purposive selection of 101 foods from 1,020 food products for the analysis of sodium, potassium, sugar, dietary fiber and fatty acid profile usingstandardized methods. Phase-IV of the study aimed at assessing consumer awareness, knowledge and practices of the subjects enrolled in Phase-I. The consumer survey aimed at finding the grey areas of food labeling and thereby, an education session was conducted among adolescents (n=230) and post data was collected to evaluate the impact of intervention.

Major findings of the Study

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

Demography

- Sixty two percent of the consumers were females and 38% were males. 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%).
- 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 family (56.9%), followed by joint family (40%) and few were single (3.1%).
- Eleven percent of the consumers had medical conditions like diabetes, hypertension, osteoporosis, thyroid dysfunction, anemia, asthma, arthritis, kidney stones, digestive tract ailments etc., of which 53% were adults, 40% were elderly and 7% were adolescents.
- Consumers with medical conditions were mostly obese (n=59, 64%) and overweight (n=13, 14%) while few were normal (n=16, 17%) and underweight (n=7, 4%).
- Four percent of the consumers had food allergies related to milk and milk products, fermented foods, almonds, groundnuts, egg and prawns.
- A positive correlation between age and BMI was observed.

Processed Packaged Food Consumption among Consumers

- The most popular foods (consumed by majority of the consumers) among consumers were sweet biscuits (86%), 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%) and pickles (51%).
- Most frequently consumed foods (≥5 times a month) were sweet biscuits, papads, salty biscuits, namkeens, pickles, ketchups and sauces, butter and cheese, soups, chips, jam, marmalades and jellies, noodles, pasta and macaroni, juices, cornflakes, oats and muesli, soft drinks, popcorn, spreads and dips, cakes and sweet cream wafers.
- Mean consumption of 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 was higher in males than females.
- Mean monthly consumption of sweet cream wafers, spreads and dips, namkeens and savories, papads and juices washigher in females than males.
- Consumption of cornflakes, oats and muesli was similar among adolescents and elderly.
- Adolescents were the major consumers of all processed packaged foods except for “butter and cheese” and “spreads and dips” which was consumed more by elderly and adults, respectively.
- More females than males consumed processed foods.
- Age and gender significantly influenced the consumption of sweet biscuits, jam, marmalades and jellies, soft drinks, ketchups and sauces, pickles, papads and namkeens and savories.
- Processed food consumption did not vary by educational qualification, profession and family type.
- Processed food consumption was influenced by medical condition of the consumers. Mean consumption of all the processed packaged foods was lower among consumers with medical condition as compared to the consumers not having any medical condition except for the soft drinks. 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.

Phase II: Market Survey

Nutrition Facts Panel

- Sixty one percent of the food products had NFP as “per 100g”, 19% of the products displayed NFP as “per 100g and per serving” and 2% of the products displayed NFP as “per serving” and only 8.4% of the products reported NFP as “per 100 g, per serving and % DV” which provide complete information and reference values to compare among brands.
- 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).
- Nine out of ten food groups did not comply with reporting of mandatory nutrients as per FSSA. Reporting of five mandatory nutrients was adhered to by all the products in only “confectionery.”
- Energy was reported in 99.8% of the products followed by carbohydrates (99.5%), protein (99.1%), fat (97.8%) and sugar (87.1%).
- Snacks and Food adjuncts complied least in reporting of all five mandatory nutrients.
- Of the total food products (n=1,020)only 365 products reported complete fat profile on NFP.
- Of the total products (n=1,020)only 144 products reported calories from fat.
- Total number of nutrients reported on food products varied over a large range from 0 to 48 nutrients.

Processed Packaged Foods High or Low in Nutrients According to US-FDA and UK-FSA Criteria

- 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.

- Of the total products that reported fat content (n=998), 42.8% products were high in fat (≥35% of the total energy from fat)as per US-FDA criteria.
- Snacks, bakery products, ready-to-cook/eat products and confectionery were the top four food groups with majority of the food products high in energy and fat content as per US-FDA criteria.
- By UK-FSA criteria, 30% (n=301) of the products 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.
- Of the 113 products that were high in sodium content (as per UK-FSA criteria), 26 products had MSG in ingredients list indicating that the high sodium content could be due to the presence of MSG.
- Ready-to-cook/eat products were found be among the top 3 food groups that were high in fat, SFA, sugar and sodium content according to the UK-FSA criteria.

Ingredients List

- Of the total 1,020 products, only 337 products listed ingredients in descending order of percentage weights. Of the 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.
- More than 50% of the products had multiple sources of ingredients of concern namely, sugar, fat, salt/sodium and MSG.
- Of the total products (n=1,020), 27% of the products had more than one source of sugar in ingredients list, followed by 11%, 11% and 4% with multiple sources of fat, salt/sodium and MSG, respectively.
- Ready-to-cook/eat products had the largest number of products with multiple sources of fat and salt in ingredients list.

- Sources of MSG 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.
- Bakery products had the highest number of products with multiple sources of sugar in ingredients list.
- 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 indicating poor substantiation of trans fat content in food products.
- 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%).

Allergen Information

- 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 declaration. Of these 802 products that did not carry advisory/precautionary declaration, 492 had one or more allergenic ingredients in ingredients list. Allergenic substance was present either in ingredients list or as an allergen advisory/precautionary declaration.
- Majority of the products had allergen advisory/precautionary declaration related to “treenuts and nuts” (n=148), followed by “milk and milk products” (n=107), “cereals containing gluten” (n=97), “peanuts, soybeans and their products” (n=79), “sesame” (n=43), “mustard seeds (n=23), “gluten free (n=12), “celery (n=5), “corn” (n=3), “sulphite” (n=2), “eggs and products” (n=1), “contains no milk or milk derivatives” (n=1). None of the products had crustaceans and fish and their products related allergen advisory/precautionary declaration.
- Of the 218 products having allergen declaration, “Type A” (e.g. contains nuts and milk) allergen information was present in 39% of the products, “Type B”(e.g. may

contain soy) in 31.7%, “Type C” (e.g. gluten free) in 2.8% and “Type D” (e.g. contain nuts, gluten free) in 26.6% of the products.

- Baby foods that are considered to be free of allergens had 0.5% of the products having allergen advisory/precautionary declaration indicating the presence of allergenic substance.

Health Claims

- Health claims were present on 8.3% of the total products.
- 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%).
- Most commonly declared health claim was “growth related” claims (1.7%) (such as, “good for growth”, “improves 5 signs of growth bone area, muscles, concentration, active nutrients and healthier blood”), followed by“Immunity related” claims (1%) (such as,“for immunity” and “strengthen natural immunity”), “memory, brain and nervous system related” claims (0.9%)(such as, “for brain development”, “supports brain development”, “helps improve memory” and “for healthy nervous system”), “heart related” and “bones and teeth related” (0.8% each). Heart related claims were reported as “heart friendly”, healthy heart” and “for strong heart” while bones and teeth related claims were reported as “for strong bones, muscles and teeth” and “strengthen bones and teeth.”

Nutrient Claims

- Nutrient claims were present in 80% of the total products.
- Wheat and oats based products carried the highest percentage (30%) of nutrient 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.
- Sixteen percent of the total products had “trans fat” related claims which were followed by vitamins and minerals related claims (13% each), cholesterol related claims (10%), fiber related claims (5%), fat related claims (5%), carbohydrates and sugar related claims (3%) and energy related claims (2%).

- Top 3 food groups that declared “trans fat” related nutrientclaims were bakery products (3.7%), wheat and oats based products (3.1%) and snacks (2.5%). “Zero TFA” claim was most common (10%) as compared to “Contain trans fat” claim (5.6%).
- Nutrient claims related to Energy, Protein, Vitamin A, Vitamin C, Iron, Zinc and Phosphorus was substantiated by the NFPs of all the products claiming the same while nutrient claims related to calcium and fiber, Vitamin D, Folate, Phosphorus and Iodine were not substantiated by the product NFPs.
- Low calorie, low fat and low cholesterol claims were not substantiated in all the products claiming the same as per the criteria laid down by Codex Alimentarius. The difference in claiming and substantiation of 0.6%, 2% and 0.1% was observed in low calorie, low fat and low cholesterol claims, respectively. However, zero cholesterol claims was completelysubstantiated.
- “Fat free” claim was completely substantiated by NFP and Ingredients list. “Zero TFA” claim was substantiated by NFP but not by ingredients list (claimed=10.1%, substantiation by ingredients list=8.8%). “No added sugar” and “Contain Trans Fat” claims were not completely substantiated both by NFP and ingredients list.

Ingredient Claims

- Fifty four percent of the total products had flavor related claims, followed by color related (44.4%), preservatives related (35.1%), MSG related (21.7%), other ingredients claim (9.5%), oil related (4.6%), grain related (4%), sugar and glucose related (2.8%), natural fruit content related (2.6%), artificial sweetener related (0.4%), gelatin related (0.3%) and salt related (0.2%) claims.
- “Fats” related claims (no hydrogenated fats, contain vegetable oils, etc.) were found in 4.6% of the products of which, “no hydrogenated fats” were found in 4.2% while “X% Less oil” and “Contain vegetable oils” were found in 0.2% of the products.
- “No hydrogenated fat”, “no added salt” and “No MSG” claim were not substantiated by ingredients list in all the products however, they were substantiated in all products by NFP i.e. “no hydrogenated fat” was claimed by 4.2% products and substantiated by all 4.2% of the products. Similarly, “”no added salt” was claimed and equally substantiated by 0.1% of the products.

Symbols and Logos

- Majority of the products (98.6%) had either vegetarian or non-vegetarian symbol followed by FPO (22.6%), ISO (12.4%), 100% natural (0.1%), HACCP (5%), Healthy Choice (2.2%), ISI (0.6%) and AGMARK (0.2%).

Manufacture and Best Before Date

- Only 58% of the products declared manufacture and best before date together at the same place.
- Majority of the products (81%) declared best before date in months (i.e. best before in nine months, or best before within 12 months etc.).
- 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 labelthereby calling for additional effort of locating manufacture and best before date whereby consumers may lose interest in looking at the same.

Phase III: Nutrient analysis of Selected Processed Packaged Foods

- Of the 101 products selected for nutrient analysis, 98% of the products reported fat content, 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 by 14% of the products.

Sodium

- Of the total products that reported sodium content on NFP (n=40), 21 products over-reported the sodium values and 13 products under-reported the same. The remaining products had similar or less than 10% variation in reported and analyzed values for sodium. Higher analyzed sodium content than the reported values was found in 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 the presence of multiple sources of sodium in the ingredients list.

- 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.
- Statistically significant difference between reported and analyzed values of sodium was observed 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.
- Of the total products analyzed for sodium content, 61 did not report sodium values on NFP and 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.

Potassium

- Of the 13 products that reported potassium content on NFP, 7 products under-reported the potassium values and 5 products over-reported the same. The remaining 1 product had less than 10% variation in reported and analyzed values for potassium. 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.

- Of the 88 products that did not report potassium content on NFP, 16% were sweet biscuits, 14% were cornflakes, oats and muesli, 14% were noodles, pasta and macaroni, 13% were namkeens and savories and 11% were chocolates. Potassium content in these food categories ranged from 0 to 1600 mg/100g. 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.
- 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). Mean analyzed 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.
- Butter and cheese had zero analyzed potassium content while the highest potassium content was found in ready-to-cook foods (990 mg/100g of food).

Sugar

- Of the 87 food products that reported sugar content, 44 products under-reported and 18 products over-reported the sugar values. Twenty five products either had similar or less than 10% variation in reported and analyzed sugar values. Fourteen products did not report sugar values. Highest reported (74.5 g/100g) and analyzed (75.5 g/100g) sugar content was found in jam, marmalades and jellies. Namkeens and savories ($p \leq 0.01$, $t=4.572$) showed significant difference between reported (4g/100g) and analyzed (7.34g/100g) sugar content. 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.

Fiber

- Of the 40 products that reported fiber content on NFP, 39 products under-reported and 1 product over-reported the fiber values. Sixty one products did not report fiber content on NFP. The present investigation revealed that the reported values were that for the “crude fiber” content while analyzed content were for “dietary fiber.” 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.

Total Fat

- Of the 99 products that reported fat values on NFP, 90 products over-reported, 9 products either had similar or less than 10% variation in reported and analyzed values and 2 products did not report fat values on NFP. 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. Mean total fat content was found to be highest in spreads and dips (reported=50.45 g/100g and analyzed=20.26 g/100g) and lowest in cornflakes, oats and muesli (reported=4.86 g/100g and analyzed=1.77 g/100g). Products 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.

Saturated Fatty Acids (SFAs)

- Saturated fatty acid values were declared in 42 food products. Butter and cheese had the highest reported and analyzed SFA content of 37 g/100g and 31.5 g/100g, respectively. Statistically significant difference was observed between the mean reported and analyzed values of SFA in chips ($p \leq 0.001$, $t = 10.275$). 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).

Mono-unsaturated Fatty Acids (MUFAs)

- MUFA was reported in 37 food products. 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 ($p \leq 0.01$, $t=4.563$). Of the 64 products that did not report MUFA values, 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. Analyzed MUFA values were highest in spreads and dips (12.2 g/100g).

Poly-unsaturated Fatty Acids (PUFAs)

- PUFA was declared in 37 food products. Reported PUFA values were highest in butter and cheese (7 g/100g) and lowest in 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 ($p \leq 0.05$, $t=2.231$), sweet biscuits ($p \leq 0.05$, $t=2.818$) and namkeen and savories ($p \leq 0.001$, $t=4.786$).Substantial amount of analyzed PUFA content 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).

Trans Fatty Acids (TFAs)

- Of the total 101 products analyzed, 44 products reported TFA content on NFP. 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. Highest analyzed TFA content was found in butter and cheese (17.2 g/100g).Though not

reporting of TFA was common in the studied products, yet they were found to contain substantial amount of TFA when analyzed.

High, Medium or Low Content of Fat, SFA, Sugar and Sodium/Salt in Analyzed Processed Packaged Foods as per UK-FSA Criteria

- According to the UK-FSA criteria, 66% of the total products analyzed for fat content had medium fat content (>3.0 to ≤20 g/100g), followed by 30% of the products with low fat content (≤3 g/100g) and only 4% of the products had high fat content (>20 g/100g).
- Saturated fat was low (≤1.5 g/100g) in 56% of the products, medium (>1.5 to ≤5 g/100g) in 19% of the products and high (>5 g/100g) in 24% of the products.
- Sugar was high (>12.5 g/100g) in majority of the products (46%), medium (>5.0 to ≤12.5 g/100g) in 31% products and low (≤5 g/100g) in 24% of the products.
- Few products (12%) were low in sodium content (≤0.3 g/100g), 44% had high (>1.5 g/100g) and 45% had medium sodium content (>0.3 to ≤1.5 g/100g).
- Majority of the products were high in sugar and sodium content as compared to total fat and saturated fat as per UK-FSA criteria.
- Noodles and namkeens and savories were high in “sodium and SFA” content, cornflakes, tomato ketchup, soups and ready to use spice mixes were high in “Sodium and Sugar” content, sweet biscuits and chocolates were high in “Sugar and SFA” content while namkeen and savories were high in “Total fat and SFA” content.
- Food products that were high in 3 nutrients namely, “Sodium, Total fat and SFA” were butter and spreads and products that were high in “Sugar, Total fat and SFA” content were from chocolates. These products were also found to contain multiple sources of fat, sugar and sodium in ingredients list.
- A higher fat content was completely substantiated by ingredients list i.e. the source of fat was among the first three ingredients in ingredients list. Similarly, 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 observed only for fat.

Fatty Acid Composition of the Analyzed Processed Packaged Foods

- 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%), Linoleinic 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. Majority of these fatty acids constitute 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 constitute MUFA, linoleic acid constitutes PUFA and elaidic and linolelaidic acid constitute TFA. Therefore, a large number of food products had SFA content.
- The predominant fatty acids(as the mean percent of total fatty acids) found in the food products 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 0-4776.4%, Caproic acid- 0.1 -976.9%, Linolelaidic acid- 0.2-914.5%, Linoleic acid- 0-456.1% and Palmitic acid- 0.1-105.4%. The first three fatty acids with highest percent means of total fat belonged to SFAs and TFAs and thus indicate that products had reasonably high amount of SFA and TFA content.
- Majority of the food categories declared the source of fat in ingredients list as “edible vegetable oil.” Only a few foods specified sources of fat such as margarine, palmolein oil, cocoa butter, butter, sesame oil, peanut oil and corn oil.
- The probable source of fat according to the analyzed 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 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 source 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.

Phase IV: Consumer Awareness and Capacity Building on Food Labeling

Knowledge and Practices of Consumers Regarding Processed Food Selection

- Variety and taste (73%) and convenience (33%) 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%).
- 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%).
- 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 common factors considered by subjects for processed food purchase.
- 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 allergen information (7%). Differences between genders were non-significant. At a 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.

- Of the total consumers, 634 consumers looked for nutrition labels. Of the 634 consumers, 64% females and 35% males reported using food labels. 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%).
- 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%).
- Females were more concerned about overall health (32%), for general knowledge (20%), specific nutrients (10%) and 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. Elderly were more concerned about overall health (6%) associated with the medical conditions affecting them.
- Of the total participants, 21.4% (n=173) reported various reasons for not reading 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%).
- 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 "certain brands" (10%). 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%).
- Age-group wise, 14% of the adults reported of 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 did not read food labels as they "do not understand" food labeling (22%).
- Of the three major sources of information namely ingredients list, NFP and symbols and logos, majority of the consumers (93%) used ingredients list for product information followed by NFP (83%) and symbols and logos (73%). However, the knowledge about the utility of the same ranged between 24% to 34% for each component.
- Females examined as well as had knowledge about the use of 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 usage of the same. The knowledge about usage of ingredients list was higher in adolescent and adults (15%) than elderly (3%). Knowledge about the use of NFP was better among adults (15%) compared to adolescents (13%) and (2%) and for symbols and logos was better among adolescents (12%) than adults (10%) and elderly (2%).

- 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 fibre (41%). Other undesirable nutrients namely, calories from fat (20%), TFA (19%), SFA (18%) and sodium (18%) were less often looked at for product selection.
- Females and adolescents were more concerned about each nutrient and looked for nutrients more often than their counterparts.
- 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.
- Familiarity among consumers towards other symbols namely, AGMARK (52%), FPO (35%), Healthy Choice (29%), Smart Choice (23%) and HACCP (9%) was average and the understanding about the same was below average.
- Understanding and use of symbol/logo 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/logos were higher in females and adolescents as compared to their counterparts.
- Understanding of NFPs was above 50% between genders and among all age-groups.
- Of the four NFPs the best comprehended NFP was NFP-2 (Nutrients given 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) and it was understood by 82% of the consumers.
- NFP-1 presented the nutrients as “per 100 g” of the product. It was understood by 67% of the consumers.

- 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.”). It was understood by 55% of the participants.
- 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. It was understood by 52% of the participants.
- 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.
- Percent knowledge scores achieved by the consumers were more on NFPs (41%) as compared to symbols and logos (30%) and other food components of food labels (usage of ingredients list, NFP and symbols and logos).
- Fat was considered by most of the consumers (27%) for evaluating NFPs, followed by energy (23%), protein (17%), vitamins (14%) and carbohydrates (13%).
- “Nutrients of concern” namely, cholesterol, sugar, TFA and sodium were considered by less than 10% of the consumers.
- 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%).
- “International Unit” (I.U.) was the least understood terminology (37%) 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%).
- Self reported data revealed that females had greater difficulty than males in understanding the terminologies on NFP. Twenty three percent females reported to have difficulty in understanding “I.U.” followed by “Microgram (14%), PUFA (14%), MUFA (14%),“% Daily Value” (13%), KJ (12%) and sodium (4%). Reported difficulty in understanding of majority of the terminologies on NFP was higher among adolescents as compared to adults and elderly.

Impact Evaluation after Intervention

- Experimental Food Label 1 (claims were placed at FOP, allergen information was placed in bold letters, ingredients list presented in descending order of percentage weight and NFP in “per 100 g” and “per serving”) was better

understood by the consumers (54%) as compared to Food Label 2 (claims were placed at BOP, allergen information was not appropriately highlighted, ingredients list was not presented in descending order of percentage weight and NFP in "per serving and % DV")which was understood by 37% of the consumers.

- Label 1 was better understood by both the genders (boys=46% and girls=58%) than Label 2 (boys=30% and girls=43%). However, girls scored better in understanding of both the food labels as compared to boys.
- At a glance information (i.e. symbols, logos, health and nutrition claims, allergen information, information about preservatives, information about colors and flavors) and ingredients list in Label 1 was better understood by the study subjects than Label 2.However, NFP in Food Label 2 was better understood by the subjects.
- Post intervention scores for symbols and logos and NFP increased by 50%. The scores for symbols and logos improved from 31% to 67% and from 30% to 60% for NFP. However, post intervention scores did not improve for ingredients list.
- There was no significant difference in the pre and post intervention mean knowledge scores of ingredients list. A statistically significant difference in the pre and post intervention mean knowledge scores of symbols and logos was observed among adolescent consumers.
- Awareness among consumers about "smart choice", "FPO" and "HACCP" increased from 3% 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 to intervention and it slipped to 60% after intervention. The probable reason for this decline could be confusion among consumers when other symbols were also there on the food labels. .
- At baseline the knowledge about nutrition claims was assumed to be nil among consumers. An increase in awareness and identification of nutrition claims among consumers was observed post intervention. It was seen that post intervention, "Zero Trans fat" claim was identified by 44% of the consumers followed by "zero cholesterol" by 42%, "low sodium" by 36%, "no MSG" by 22% and "no preservatives" by 18%. Therefore, it can be concluded that nutrition claim understanding increased appreciably after intervention.
- 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.

Conclusions

The major conclusions that emerge from the present study are,

- Presence of medical condition effects processed packaged food consumption. Consumers with medical condition are more cautious while selecting food product for consumption.
- Adolescents are the major consumers of processed food. Therefore, they should be the primary target group for creating awareness.
- Lack of compliance with FSSA guidelines is observed in presenting nutrition information namely, nutrition and health claims, ingredients list, allergen declaration and NFP on food labels.
- Majority of the food labels are not presented in dual language (English and local language).
- There is lack of substantiation of nutrient and health claims by ingredients list and NFP.
- There is lack of compliance in listing ingredients in descending order of percentage weights as per FSSA.
- Presence of multiple sources of “ingredients of concern” namely, fat, salt/sodium, sugar and MSG with alternative names is common in majority of processed packaged foods.
- There are inconsistencies in the formats of NFPs used on food labels.
- There is lack of compliance in reporting five mandatory nutrients by majority of the food products.
- Variation in reported and calculated values of “nutrients of concern” namely, sugar, sodium, potassium, fiber, total fat, SFA and TFA is prevalent.
- There is lack of uniformity in presenting information like, allergen declaration, manufacture and best before date and information about colors, flavors and preservatives.
- There are ambiguities in presenting allergen information on food labels that bring challenges to consumers with food allergy.
- Positioning, specific format and language to declare allergens has not been specified by the regulating agencies. Complete information about allergen

declaration was not being displayed on the food packages, which is a matter of concern.

- Allergenic substance was present either in ingredients list or as allergen advisory/precautionary declaration.
- There is 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.
- Food products that do not report “nutrients of concern”, namely, fat, sodium, sugar, saturated fat and trans fat are usually high in these nutrients.
- At a glance information is easy to understand and interpret by the consumers.
- Consumer awareness sessions have positive effect on consumers understanding and interpretation skills about food labels.
- Comprehension of the food labels by the consumers can be improved trough awareness generation.
- When the claims are placed at FOP, allergen information is placed in bold letters, ingredients list 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.
- Complexity or the amount of information on NFPs increases the difficultly in comprehension.

Recommendations that emerge from the present study are essentially of 4 types,

1. Awareness generation

- Lack of awareness and knowledge among consumers about the utility of food labels and inclination towards non-nutritional factors while product selection calls for a need to provide education on food labeling to promote label use for healthy food choices.
- Messages and campaigns aimed at helping individuals to manage their “nutrients of concern” should be initiated.
- Various consumer nutritional education activities can be initiated in schools, colleges, media (especially television), MNCs and in-store presentations by store personnel.
- Specific target groups (such as consumers with diet-related diseases) should be informed by means of workshops on the importance of food labels.

- Store personnel could be the source of nutrition information, the staff at food stores should be made aware of the importance of nutrition and should be provided with the necessary skills in order to assist consumers in assessing information on food labels.

2. Encouraging food processors to adopt healthy food processing technology

- Food manufacturers should be encouraged and incentives should be given to bring about healthy food processing.
- Food manufacturers should be encouraged to have their own research and development departments for nutrient analysis of their products or they should be given subsidies for getting their foods analyzed in accredited laboratories in order to encourage them to use actual analyzed nutrient values on NFPs.
- Strategies need to be adopted to either decrease the consumption of HVO or to modify the industrially produced HVO in order to decrease the TFA content to safeguard the health of consumers.

3. Developing clear guidelines for Nutrition Labeling

- Nutrition information should be legible. Appropriate font size should be used with light background.
- Clear guidelines (with respect to uniformity, positioning and format) on reporting of symbols and logos, nutrient and health claims, ingredients list, allergen information, NFP, information about colors, flavors and preservatives, manufacture and best before date, needs to be developed.
- Reporting of “nutrients of concern” namely, total fat, SFA, TFA, sodium, potassium, sugar and fiber should be made mandatory so as to help consumers make healthy food choices. Reporting of complete fat profile should be made mandatory.
- There is a need design simplified food labels and decrease complexity and include colors and pictures in order to capture consumer attention.
- Food labels should be able to convey numeric nutrition information in simpler and more meaningful ways, such as through interpretive food labels, the addition of simple text, increase clarity about terminologies, functions of nutrients, easy-to-understand presentation of serving size information.
- Legislation should be improved to minimize variation in reporting of nutrients.

- Regular auditing of the processed packaged foods should be carried out so as to improve their compliance towards substantiation of nutrition information.

4. Strict legislations and implementations of food laws

- Regular and surprise auditing of the food manufacturing plants, supermarkets and grocery stores should be carried out to check on the malpractices related to food manufacturing and selling.
- Manufacturers and suppliers who abide by the laws should be promoted and given incentives.