Vitamin A Fortified Edible Oils and Rice: The Knowledge Level and Consumption Rate among Different Place of Residences in Tangail District, Bangladesh

Rokeya BEGUM1, Nannur RAHMAN1,2, Rakibul HASAN1, Yusuf JAMIL1, Sanjida Anjom TAMANNA1 and Robiul ISLAM1

1 Department of Food Technology and Nutritional Science, Faculty of Life Science, Mawlana Bhashani Science and Technology University, Santosh, Tangail–1902, Bangladesh
2 Department of Microbiology, Faculty of Medicine, Chinese University of Hong Kong, Shatin, Hong Kong

(Received July 28, 2020)

Summary A population based cross-sectional study was conducted in four residential areas of Tangail Sadar Upazila, Bangladesh aiming to explore the knowledge about vitamin A fortified edible oils and rice as well as the their consumption rate. A total of 400 participants were randomly selected. Data were collected through face to face interviews. Only 15.0% and 3.5% participants had knowledge about vitamin A fortified edible oils and rice respectively. Precisely vitamin A fortified edible oils knowledge level was found inferior in rural (11.7%) and slum (0%) than urban (48.3%) and semi-urban (40.0%) participants. Knowledge about vitamin A fortified rice was found higher in urban (78.6%) than rural (14.3%) and slum (0%) participants. Most of the participants received knowledge through advertisements (N=45 and N=12 for fortified oils and rice respectively). Maximum participants (62.3%) did not consume vitamin A fortified edible oils and consumption rate in rural (11.8%) and slum (10.2%) areas were poorer than urban (53.5%) and semi-urban (24.4%) areas. Consumption rate of vitamin A fortified rice was found nil in all the study areas. Lack of knowledge about vitamin A fortified rice and oils accounted solely for poor consumption. Knowledge level about vitamin A fortified edible oils and rice and consumption rate were found statistically significantly \( p<0.05 \) with participant’s place of residences, education level and monthly income. Finally, this study indicates that the overall knowledge level and consumption rate of vitamin A fortified edible oils and rice is poor especially in rural and slum populations in Tangail Sadar Upazila.

Key Words nutritional knowledge, vitamin A fortified foods, intake pattern, socio-demographic factors, rural, urban

Micronutrients such as vitamins and minerals play an important role in the promotion of health and prevention of disease (1). Global estimates show that one third of the world’s preschool-age population suffers from vitamin deficiency disorders and the populations from South Asian developing countries are the most vulnerable groups (2). An estimated 250,000 to 500,000 vitamin A deficient children become blind every year, half of them dying within 12 mo of losing their sight (3). Vitamin A deficiency affects about 19 million pregnant women and 190 million preschool-age children, mostly from Africa and South-East Asia (4). Vitamin A deficiency alone is responsible for almost 8% of deaths among children under the age of 5 y in South-East Asia (5). Many factors contribute to micronutrient deficiencies, such as diets with low nutrient quality and diversity, low household purchasing power, inadequate access to drinking water, sanitation facilities, inadequate knowledge of nutritional practices, and inequality (6). Vitamin A deficiency has long been identified as a serious public health problem in Bangladesh. The Government of Bangladesh has initiated various aiding programs to reduce this public health problem e.g. distribution of vitamin A capsule, fortification of edible oils and rice by vitamin A. Food fortification with vitamin A is a feasible and cost effective approach to reduce vitamin A deficiency. In Bangladesh, edible oil is a suitable vehicle for vitamin A fortification because of the advantages such as centralized processing, widespread distribution, and high consumption (7). According to a previous report 99% of the Bangladeshi population consumes vegetable oils at full implementation (8). According to “National Edible Oil Fortification Law, 2013” Bangladesh Standards and Testing Institution (BSTI) set standards for 4 types of fortified oils except for mustard oil and vitamin A content must be at 15 to 30 ppm per 100 g of oil (9). Fortified rice holds great potential for bringing essential micronutrients to a large part of the world population as it is the staple food in many countries (10). Vitamin A fortified rice is a potential intervention strategy to prevent vitamin A deficiency in at risk populations (11). Globally, the use of fortified rice has improved micronutrient intake and reduced micronutrient deficiencies in several countries.

E-mail: rokeya15@yahoo.com
In Bangladesh, rice fortification is supported by the government and the World Food Programme (WFP) with funding from the Netherlands government. The production of fortified rice in this project took place in two steps: i) the production of fortified rice kernels and ii) the homogeneous blending of fortified rice with un-fortified rice, usually at a 1:100 ratio. The micronutrient fortificants used to fortify the rice per 100 g fortified rice includes vitamin A (150 μg), vitamin B1 (0.4 μg), vitamin B12 (1 μg), folic acid (130 μg), iron (6 mg), and zinc (4 mg) (13).

Consumer's knowledge and consumption rate of vitamin A fortified edible oils and rice in Tangail regions were hardly reported before. In this study, the present scenario of knowledge about vitamin A fortified edible oils and rice as well as their consumption rate among various residential areas of Tangail district were assessed comprehensively. Besides this study also identified potential reasons behind less consumption of fortified foods and investigated various socio-demographic influencing factors on participant's knowledge level and consumption rate.

**MATERIALS AND METHODS**

**Study area.** The study which was descriptive population based cross sectional in design was conducted in Tangail city (urban), Santosh (semi-urban), Porabari (rural), and North Akur-Takur para (slum) of Tangail district in Bangladesh. This research was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of the Mawlana Bhashani Science and Technology University [Approval Number: MBSTU/FTNS/ERB/2019(02)].

**Sample size determination.** The sample size was determined using the sample size formula for single proportion

\[
n = \frac{z^2 \times P \times q}{d^2}
\]

Where \( n \) is the minimum sample size, \( Z = 1.96 \) corresponding to 95% confidence interval, \( P=0.052 \) (14), \( d=\)level of precision taken at 5% acceptable margin of error, and \( q = 1 - P \).

The sample size as following using, \( P=0.052, q = 0.948, d=0.05, Z=1.96 \).

\[
n = \frac{1.96 \times 1.96 \times 0.052 \times 0.948}{0.05 \times 0.05}
\]

\[
n = 75.72
\]

\[
n = 75.72 + 10\% \text{ allowance for nonresponse}
\]

\[
n = 75.72 + 7.572 = 83.272
\]

The sample size calculation using \( P=0.052 \) from Senbanjo and Adejuyigbe (14) yielded a sample size of 83.

---

1. BDT: Bangladeshi Taka.

| Characteristics | Residence N (%) |
|-----------------|-----------------|

| N | Urban (N=100) | Semi-urban (N=100) | Rural (N=100) | Slum (N=100) | Total (N=400) |
|---|--------------|-------------------|-------------|-----------|-------------|
| **Sex** | | | | | |
| Male | 32 (45.7) | 15 (21.4) | 20 (28.6) | 3 (4.3) | 70 (17.5) |
| Female | 68 (20.6) | 85 (25.8) | 80 (20.0) | 97 (29.4) | 330 (82.5) |
| **Age (y)** | | | | | |
| 21–30 | 4 (13.8) | 4 (13.8) | 7 (24.1) | 14 (48.3) | 29 (7.3) |
| 31–40 | 32 (20.8) | 39 (25.3) | 43 (27.9) | 40 (26.0) | 154 (38.5) |
| 41–50 | 37 (27.0) | 39 (28.5) | 36 (26.3) | 25 (18.2) | 137 (34.3) |
| >50 | 27 (33.8) | 18 (22.5) | 14 (17.5) | 21 (26.3) | 80 (20.0) |
| **Current employment status** | | | | | |
| Govt. Service | 21 (60.0) | 11 (31.4) | 2 (5.7) | 1 (2.9) | 35 (8.8) |
| Non Govt. Service | 28 (46.7) | 16 (26.7) | 11 (18.3) | 5 (8.3) | 60 (15.0) |
| Business | 34 (26.8) | 41 (32.3) | 33 (26.0) | 19 (15.0) | 127 (31.8) |
| Agriculture | 0 (0) | 9 (26.5) | 25 (73.5) | 0 (0) | 34 (8.5) |
| Housewife | 8 (13.3) | 17 (28.3) | 14 (23.3) | 21 (35.0) | 60 (15.0) |
| Others | 9 (10.7) | 6 (7.1) | 15 (17.9) | 54 (64.3) | 84 (21.0) |
| **Education level** | | | | | |
| Graduate and above | 22 (68.8) | 7 (21.9) | 3 (9.4) | 0 (0) | 32 (8.0) |
| Higher Secondary Certificate (HSC) | 13 (39.4) | 11 (33.3) | 7 (21.2) | 2 (6.1) | 33 (8.3) |
| Secondary School Certificate (SSC) | 37 (37.8) | 35 (35.7) | 20 (20.4) | 6 (6.1) | 98 (24.5) |
| Primary | 11 (10.5) | 30 (28.6) | 32 (30.5) | 32 (30.5) | 105 (26.3) |
| Illiterate | 17 (12.9) | 17 (12.9) | 38 (28.8) | 60 (45.5) | 132 (33.0) |
| **Household monthly income (BDT)\(^1\)** | | | | | |
| <10,000 | 8 (5.2) | 19 (12.3) | 50 (32.5) | 77 (50.0) | 154 (38.5) |
| 10,000–20,000 | 16 (13.6) | 47 (39.8) | 35 (29.7) | 20 (16.9) | 118 (29.5) |
| 20,000–30,000 | 30 (43.5) | 23 (33.3) | 13 (18.8) | 3 (4.3) | 69 (17.3) |
| 30,000–40,000 | 19 (90.5) | 1 (4.8) | 1 (4.8) | 0 (0) | 21 (5.3) |
| >40,000 | 28 (73.6) | 10 (26.3) | 0 (0) | 0 (0) | 38 (9.5) |

\(^1\) BDT: Bangladeshi Taka.
To have a larger sample size, \( P = 0.5 \) was used for this study.

\[
n = \frac{1.96 \times 1.96 \times 0.5 \times 0.5}{0.05 \times 0.05} = 384.16\quad n = 385
\]

A total of 400 participants were recruited during the study in the four residential areas of Tangail district, Bangladesh.

**Sampling procedure.** A total of 400 apparently healthy participants were recruited for the study using a three stage systematic random sampling procedure. In first stage a sampling frame of all the residential areas in Tangail Sadar Upazila was drawn and stratified into urban, semi-urban, rural and slum areas. In second stage a sampling frame of all the communities in the selected residential areas was drawn. And in final stage 400 participants were selected from four residential areas using a systematic random sampling technique and conveniently based on eligibility criteria. Most of the study participants were women as one of the intention of the study was to assess the consumption frequency of vitamin A fortified edible oils and rice, usually in Bangladesh women are solely responsible for maintaining the culinary activities and also have more precise consumption information.

**Questionnaire development and data collection.** A questionnaire was developed containing both closed and open ended questions to obtain relevant information on the demographic, socio-economic, dietary condition, and consumption rate of vitamin A fortified edible oils and rice. All questions were designed, modified, and resettled to obtain and record information easily.

**Statistical analysis.** Collected data was coded and entered in the computer and analyzed by using Statistical Package for Social Science (SPSS) program for Windows Version 18.0 (SPSS 18.0, Chicago, IL, USA). Descriptive statistics [cross tabulation, Chi-square test \((\chi^2)\)] were used to describe both categorical and numerical variables. All the participants received an explanation before becoming a study participant and completed an informed consent form.

### RESULTS

The socio-demographic characteristics of the study participants are shown in Table 1. The sample had a different distribution of males (17.5%) and females (82.5%). Most of the participants were from the ‘younger’ group between 31–40 (38.5%) and 41–50 y (34.3%). Only 20% were from the ‘older elderly’ group (>50 y old). Most of the participants (31.8%) earned their livelihood through doing business and least number of participants (8.8%) found to do government services. No participants from urban and slum areas found to be associated with agricultural activities.

The educational levels of the participants were illiterate (33.0%), primary (26.3%), SSC (24.5%), HSC (8.3%) and graduate and above (8%) recorded. Most of the graduate (68.8%) and illiterate (45.5%) participants were from urban and slum areas respectively. The majority of the respondent’s household monthly income was less than 10,000 BDT (38.5%) and most of these lower household incomes recorded in rural (32.5%) and slum (50.0%) areas. In contrast higher household
income (above 40,000 BDT) was recorded in urban (73.6%) and semi-urban (26.3%) areas.

Before analyzing participant’s consumption rate of vitamin A fortified edible oils and rice, their knowledge about respective fortified food products was analyzed comprehensively with participant’s place of residences and education level as well. Table 2 revealed that only 15.0% and 3.5% participants had knowledge about vitamin A fortified edible oils and rice respectively. Most of these participants were from urban and semi-urban areas. Knowledge level about fortified edible oils and rice was found poor in rural area and nil (0%) in slum areas. Knowledge about vitamin A fortified edible oils and rice was found strongly associated ($p < 0.05$) with participant’s place of residences.

Table 3 shows that the participants with graduation (26.7%) and secondary level education (35.0%) had knowledge about vitamin A fortified edible oils and those who didn’t have any knowledge were illiterate (36.5%) mostly. Similar trend was also observed in knowledge about vitamin A fortified rice where participants with graduation (42.9%) and secondary level education (42.9%) had knowledge about vitamin A fortified rice mostly. Participant’s education level significantly ($p<0.05$) influenced their knowledge level about vitamin A fortified edible oils and rice.

From Table 2 it was found that only 15% ($n=60$) and 3.5% ($N=14$) participants had knowledge about vitamin A fortified edible oils and rice respectively. Figure 1 revealed the sources of knowledge among participants from different study areas. It showed that among 60 participants who were aware of vitamin A fortified edible oils most of them ($N=45$) learned through commercial advertisements telecast in both print (newspaper, magazines etc.) and electronic media (television, radio etc.) whereas neighbors ($N=2$) and shopkeepers ($N=1$) played a small role as a source of knowledge. Advertisements also found to be an effective medium for disseminating vitamin A fortified rice knowledge. Though very poor number ($N=14$) of participants had this knowledge, most of them ($N=12$) learned through commercial advertisements.

Among 400 participants only 37.8% participants consumed vitamin A fortified edible oils where 31.8% consumed it on regular basis and 6.0% participants stated that they consumed it irregularly meaning consumed both fortified and unfortified varieties of edible oils. Regular consumption was found higher in urban (53.5%) and semi-urban (24.4%) areas than rural (11.8%) and slum (10.2%) areas. A large number of participants (62.3%) didn’t consume vitamin A fortified edible oils at all and most of them from slum (33.7%)
and rural (31.3%) areas. Table 4 also revealed that participants' place of residences also significantly (p<0.05) influenced their consumption of vitamin A fortified edible oils. Remarkably vitamin A fortified rice consumption was found nil in all residential areas as no participants consumed vitamin A fortified rice at all.

Table 5 revealed the consumption rate of vitamin A fortified edible oils and rice with participant's level of education. It showed that participants with secondary level of education (33.1%) mostly consumed vitamin A fortified edible oils than primary (18.9%) and illiterate (17.3%) participants. In contrast participants who didn’t consume vitamin A fortified edible oils at all mostly illiterate (43.4%) and had primary (30.5%) education. Consumption of vitamin A fortified edible oils found statistically significant (p<0.05) with participant's level of education. On the other hand vitamin A fortified rice consumption was recorded nil in earlier Table 4 hence there was no distribution of vitamin A fortified rice consumption found with participant’s education level.

Consumer’s economic condition may have a strong influence on food purchasing decisions. Table 6 portrayed study participants consumption rate along with their monthly incomes. It revealed an ascending order of consumption rate (Yes) of vitamin A fortified edible oil with increasing participant’s monthly income except groups with 30,000–40,000 BDT. Consumption of vitamin A fortified edible oils found statistically significant (p<0.05) with participant’s monthly income.

From Table 4 it was revealed that a large number of participants (N=249) didn’t consume vitamin A fortified edible oils.

Many potential reasons may aggravate participant’s consumption rate which are depicted in Fig. 2. Among many reasons most of the participants (N=217) stated that they didn’t consume because they didn’t have any knowledge about vitamin A fortified edible oils and its health benefits as well. Poor knowledge level was found highest in rural (N=72) and slum (N=73) areas and solely responsible for poor consumption. Among 249 participants small number of them accounted high price (N=20) as a latent reason and in slum areas (N=11) it solely accounted for less consumption because they think fortified bottled oils is very expensive. Less consumption due to ignorance was found smaller (N=12) among total participants (N=249) and found highest in urban (N=7) areas.

There were no participants found in any residential areas who consumed vitamin A fortified rice (Table 4). Figure 3 discovered that among total participants 387 have reported that they didn’t have any knowledge about vitamin A fortified rice and this poor knowledge was found similarly accounted in all study areas such as

| Consumption of | Education N (%) | p value (χ²) |
|----------------|-----------------|-------------|
| Vitamin A fortified edible oils | Graduation and above | HSC | SSC | Primary | Illiterate | Total |
| Yes | 21 (16.5) | 18 (14.2) | 42 (33.1) | 24 (18.9) | 22 (17.3) | 127 (31.8) | 0.000 (71.447) |
| No | 10 (4.0) | 10 (4.0) | 45 (18.1) | 76 (30.5) | 108 (43.4) | 249 (62.3) | 0.050 |
| Rarely | 1 (4.2) | 5 (20.8) | 11 (45.8) | 5 (20.8) | 2 (8.3) | 24 (6.0) | 0.000 (71.447) |

| Vitamin A fortified rice | Yes | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| No | 100 (25.0) | 100 (25.0) | 100 (25.0) | 100 (25.0) | 400 (100.0) |
| Rarely | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

| Consumption of | Monthly income (BDT) N (%) | p value (χ²) |
|----------------|----------------------------|-------------|
| Vitamin A fortified edible oils | <10,000 | 10,000–20,000 | 20,000–30,000 | 30,000–40,000 | >40,000 | Total |
| Yes | 23 (18.1) | 24 (18.9) | 35 (27.6) | 16 (12.6) | 29 (22.8) | 127 (31.8) | 0.000 (107.232) |
| No | 124 (49.8) | 89 (35.7) | 25 (10.0) | 4 (1.6) | 7 (2.8) | 249 (62.3) | 0.000 (107.232) |
| Rarely | 7 (29.2) | 5 (20.8) | 9 (37.5) | 1 (4.2) | 2 (8.3) | 24 (6.0) | 0.000 (107.232) |

| Vitamin A fortified rice | Yes | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| No | 100 (25.0) | 100 (25.0) | 100 (25.0) | 100 (25.0) | 400 (100.0) |
| Rarely | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

1 BDT: Bangladeshi Taka; Statistically significant when p<0.05.
urban (N=90), semi-urban (N=99), rural (N=98) and slum (N=100) for nil consumption. The second most probable reason was reported market unavailability (N=11) of vitamin A fortified rice. Only 2 participants reported that they didn’t consume vitamin A fortified rice because they assumed it expensive.

**DISCUSSION**

In this study, the small percentage of our participants had knowledge about vitamin A fortified edible oils (15.0%) and rice (3.5%). The results of this study are consistent with the survey on knowledge of food fortification and nutrition that found Tanzanian consumers are not fully aware of food fortification (15). When enquired about which foods are fortified with vitamin A 10% responded that margarine is fortified with vitamin A and 3% responded that edible oils is fortified with vitamin A. Similar study done in Australia that reported recognition of the term “fortification” to be very low among consumers though they heard about adding vitamin and minerals in food (16). The results of this study showed significant levels of food fortification awareness among respondents who attained secondary education and graduation. Similar findings were reported by Linda et al. (17) where authors found improved food fortification awareness among respondents with secondary and tertiary level of education. Thus the attainment of higher education can increase the ability to understand and store nutrition information long enough as memory and later use it to a food-related decision (18). Poor knowledge about food fortification was also found by Kasankala et al. (19) among mother/child caretakers in Kinondoni municipality and only 29% responded that have heard the term food fortification. Regarding the sources of food fortification information, our results revealed that most of the participants who were aware of fortified edible oils and rice learned through advertisements telecast in print and electronic media. Our findings confirm Groote and Kimenju’s (20) findings that reported electronic media more precisely radio as one of the most important sources of food fortification information. According to Kasankala et al. (19) and Linda et al. (17) mass media both electronic and print such as television, newspapers...
and radio played an important role in disseminating food fortification information. In contrast, other findings were reported on the awareness of food fortification in the Philippines that food stores and supermarkets followed by radio were the main sources of information mentioned by mothers with malnourished children (21). Other studies on consumer awareness of food fortification in Kenya revealed that the main source of information on food fortification reported by consumers was media (22). Another study in India reported media and read on the products labels aid most in disseminating food fortification knowledge among mail adults (23). Therefore, dissemination of food fortification knowledge through media (print and electronic) would be more effective in the study area. Our study found that commercially produced vitamin A fortified edible oils was consumed by only 37.8% (31.8% regularly and 6% irregularly) study participants. Global Alliance for Improved Nutrition and Oxford Policy Management (24) conducted a survey in several provinces in Pakistan and consumption rates of fortified edible oils were 39%, 31% and 20% in Balochistan, Punjab and Sindh respectively which is consistent with the findings of current study. Current study also revealed that consumption rate of vitamin A fortified edible oils was higher in urban and semi-urban areas than rural and slum areas. In Bangladesh, total oil and fat intake on national basis is low (26.8 g/capita/d) and in the same study comparative analysis revealed that edible oils consumption is higher in urban (29.57 g/capita/d) than rural (25.70 g/capita/d) areas (25). Different consumption rates due to geographical differences was also reported by GAIN (26) and stated that in Afghanistan nationwide consumption rate of fortified edible oils was 30.1%, precisely it reported that consumption rate was higher in urban areas (55.6%) than rural areas (27.6%) in Kabul which is similar to current findings. Despite the potential for broad reach of fortifiable edible oils, many studies have shown that the access to fortified foods is not equitable and the coverage is sometimes lowest among those that need the intervention the most (27, 28). Along those lines, our results show that rural and slum participants have lower coverage of vitamin A fortified edible oils than urban and semi-urban areas. Consumption rate of vitamin A fortified rice was found nil in all study areas. These may be due to market unavailability of vitamin A fortified rice or there was no Government’s social safety net programs under which the study participants would get fortified rice with zero cost. There are various reasons for less consumption of fortified food products; however, these are seldom well-researched and reported (27). Inequities in access to and consumption of fortifiable staple products include geographic inequities (urban, rural divide) and differences in age groups (29). Our study found some similar inequities in consumption rate with geographical differences, respondent’s education level and monthly income as well. Research that does exist in Bangladesh, suggests that fortified oils may be less available in poorer areas and, when available, may be prohibitively expensive for households in poverty (30). Our study confirmed that participants with less monthly income tend to consume less fortified edible oils. In the current study most of the study participants acknowledged that only lack of knowledge regarding the benefits of fortified edible oils and rice consumption may be the prime reason for less consumption whereas small percentage of them considered high price also as a potential reason. Economic reasons and non-availability may be a potential reason for less consumption of fortified foods (31). In contrast a survey report by Ipsos-Eureka (32) a large proportion of participants expressed concern that fortified foods would be more expensive than non-fortified foods which may influence consumer’s purchasing decisions.

CONCLUSION

Different groups of populations from different residential areas of Tangail district differ in terms of educational level as well as knowledge about vitamin A fortified edible oils and rice. The consumption rate also varies in different study regions. Most negative findings were found in slum and rural areas (e.g. lack of knowledge, poor consumption level, etc.) From a public health perspective this is crucially important and should implement more effective nutritional educational programs to make rural and slum populations aware of vitamin A fortified foods. Different health promotional approaches must be made to make them understand the importance of consumption of vitamin A fortified edible oils and rice. The government of Bangladesh should also increase the market availability of vitamin A fortified rice especially. Moreover, new intervention strategies are recommended for increasing the access to fortified foods and the coverage among those who need the intervention the most.

In conclusion the present results suggest that vitamin A fortified edible oils and rice knowledge and consumption rate is inferior in rural and slum areas than urban and semi-urban areas. Study participant’s socio-demographic factors could significantly influence their knowledge level as well as consumption rate. Further study using larger samples is needed to support the present findings.

Authorship

Research conception and design: RB; questionnaire development: RB, MNR and MRH; data collection: RI, MYJ and SAT; statistical analysis of the data: MRH; interpretation of the data: MRH and MNR; writing of the manuscript: MRH; primary review and supervision: RB and MNR.

Disclosure of state of COI

All authors declare no conflict of interest.

Acknowledgments

The authors would like to acknowledge the Ministry of Education, the Government of the People’s Republic of Bangladesh for their financial assistance for the
research project entitled “Assessment of stability of vitamin A in fortified edible oils and rice during prolong storage and heating (PCN Number: LS 2017583)” under which this survey has been conducted.

REFERENCES

1) Paul AL. 1998. Overview of key nutrients: micronutrient aspects. Nutr Rev 56: 34–39.
2) Akhtar S, Ismail T, Atukorala S, Arollapa N. 2013. Micronutrient deficiencies in South Asia—Current status and strategies. Trends Food Sci Tech 31: 55–62.
3) World Health Organization (WHO). 2018. Micronutrient deficiencies fact sheets.
4) World Health Organization (WHO). 2011. Guideline: Vitamin A supplementation in infants and children 6–59 months of age.
5) World Health Organization (WHO). 2009. Global health risks: Mortality and burden of diseases attributable to selected major risks.
6) Ahmed F, Prendiville N, Narayan A. 2016. Micronutrient deficiencies among children and women in Bangladesh: progress and challenges. J Nutr Sci 5: 1–12.
7) Laillou A, Panagides D, Garrett GS, Moench-Pfanner R. 2013. Vitamin A fortified vegetable oil exported from Malaysia and Indonesia can significantly contribute to vitamin A intake worldwide. Food Nutr Bull 34: 72–80.
8) Fiedler JL, Lividini K, Bermudez OI. 2014. Estimating the impact of vitamin A-fortified vegetable oil in Bangladesh in the absence of dietary assessment data. Public Health Nutr 18(3): 414–420.
9) Bangladesh Standard and Testing Institution (BSTI). 2014. Bangladesh standards Specification for vegetable oils. BDS 1769 (Fortified soybean oil).
10) Wieringa FT, Laillou A, Guyondet C, Jallier V, Moench-Pfanner R, Berger J. 2014. Stability and retention of micronutrients in fortified rice prepared using different cooking methods. Ann NY Acad Sci 1324(1): 40–47.
11) Pinkaew S, Wegmuller R, Wasanwitsut E, Winichagoon P, Hurrell RF, Tanumihardjo SA. 2014. Triple-fortified rice containing vitamin A reduced marginal vitamin A deficiency and increased vitamin A liver stores in school-aged Thai children. J Nutr 144(4): 519–524.
12) Ara G, Khanam M, Rahman AS, Islam Z, Farhad S, Sanin KI, Ahmed T, Khan SS, Rahman MM, Majoor H. 2019. Effectiveness of micronutrient-fortified rice consumption on anemia and zinc status among vulnerable women in Bangladesh. PloS One 14(1): 0210501.
13) Pee S. 2014. Proposing nutrients and nutrient levels for rice fortification. Ann NY Acad Sci 1324(1): 55–66.
14) Senbanjo IO, Adejuyigbe EA. 2007. Prevalence of overweight and obesity in Nigerian preschool children. J Nutr Health 18(4):391–399.
15) Global alliance for improved nutrition (GAIN). 2016. Increasing quality and awareness of fortified foods in Tanzania.
16) Rowland E, Dugbaza J, House B. 2010. Consumer awareness. Attitudes and Behaviours to Fortified Foods. FSANZ, Canberra, Australia.
17) Linda AA, Kjallo E, Okoth JK, Kahenya P, Makokha A, Sila D, Mwai J. 2020. Food fortification: The level of awareness among Kenyan consumers. J Nutr Metab 2020: Article ID 8486129.
18) Soederberg LM, Cassady DL. 2015. The effects of nutrition knowledge on food label use: a review of the literature. Appetite 92: 207–216.
19) Kasankala ML, Kitunda M, Mushumbusi DG, Cyprian CM, Meghji WP, Mgbia MC, Towo E. 2014. Knowledge and awareness on food fortification among mother/child caretakers of Kinondoni Municipality, Tanzania. Asian Food Sci J 2(2): 1–13.
20) Groote HD, Kimenju SC. 2012. Consumer preferences for maize products in urban Kenya. Food Nutr Bull 33(2): 99–110.
21) Cecil TC, Jigzawel DFB. 2008. Awareness on Food Fortification among Mothers with malnourished children in selected Barangays at Mugpet and Tulzman, Cotabato, Philippines. University of Southern Mindanao Research & Development (USM R&D) ISSN 0302-7937; 16(2): 35–44.
22) Kennedy OP, David JO, Julius JO. 2014. Consumer awareness of food fortification in Kenya: The case of vitamin A fortified sugar. Paper prepared for presentation at the International Food and Agribusiness Management Association (IFAMA) 24th annual world symposium to be held in Cape Town, South Africa, 16–17 June, 2014.
23) Rekha B, Akshata PC. 2017. A study on awareness and consumption of fortified foods among male adults of Mumbai. Int J Adv Res 5(11): 403–413.
24) Global Alliance for Improved Nutrition and Oxford Policy Management. 2018. Fortification Assessment Coverage Toolkit (FACT) Survey in Pakistan. 2017. Global Alliance for Improved Nutrition, Geneva, Switzerland.
25) Bangladesh Bureau of Statistics. 2019. Household income and expenditure survey Bangladesh (HIES), 2016. Ministry of Planning, Government of the People's Republic of Bangladesh.
26) Global Alliance for Improved Nutrition. 2018. Fortification Assessment Coverage Toolkit (FACT) Survey in Afghanistan. 2017. Global Alliance for Improved Nutrition, Geneva, Switzerland.
27) Zamora G, De-Regil LM. 2014. Equity in access to fortified maize flour and corn meal. Ann NY Acad Sci 1312: 40–53.
28) Imhoff-Kunsch B, Flores R, Dary O, Martorell R. 2007. Wheat flour fortification is unlikely to benefit the neediest in Guatemala. J Nutr 137(4): 1017–1022.
29) Dary O, Mora JO. International Vitamin A Council. 2002. Food fortification to reduce vitamin A deficiency: International Vitamin A Consultative Group recommendations. J Nutr 132(9): 2927S–2933S.
30) Choudhury RA, Costa MC. 2012. Impact of government law on edible oil supply chain in Bangladesh perspective. Int J Sup Chain Mgt 1(1).
31) Nagaraj A, Yousuf A, Ganta S. 2013. Perception of rural and urban mothers about consumption of targeted fortified products in Juipur, Rajasthan—India: A cross-sectional study. Health Promot Perspect 3(1): 64–72.
32) Ipsos-Eureka. 2010. Consumer Awareness, Attitudes and Behaviours to Fortified Foods, Prepared for Food Standards Australia New Zealand. Project 09-003975-01.