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Consumers' Knowledge and Perception of Food Additives: A Study of Galle Municipal Area in Sri Lanka

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ABSTRACT

Food additives are substances added to food in order to maintain or improve the taste, texture, safety, freshness or appearance. Food additives have been found to cause various health problems such as allergies, hormone imbalances, cancers, fertility problems, obesity and hyperactivity. Limited data is available regarding the consumer's knowledge and perception of food additives in Sri Lanka. This descriptive cross -sectional study was conducted to assess the consumers' knowledge and perception on food additives to use the findings to improve those aspects. Study sample consisted of 305 participants aged 30-50 years from Galle municipal area. Data were collected by using a pre-tested self-administered questionnaire. Data were analyzed by using SPSS software version 22.0. Results indicated that the knowledge score on food additives in 73.7% of the participants was poor, 20.7% were an average knowledge level, and 5.6% had having good knowledge. Only 36.1% of participants knew about the "E" numbers in foods, and 89.8% of participants believed food additives cause an adverse effects on their health. Majority (79.3%) had the habit of reading food labels. About 71.2% of participants do not frequently consume packed foods. Only 34.4% of participants knew about mono-sodium glutamate. The level of knowledge on food additives is significantly different among the respondents with different education levels (p=0. 001) and occupations (p=0.012). Females have the habit of reading food labels more than males (p=0.032). Tamil and Muslim consumers use more food additives than Sinhalese people, and graduates had a limited usage than the others. Usage of food additives showed significant differences among the respondent's educational levels (p=0.019) and ethnicity (p=0.009). The necessity of educating public on the adverse health effects of food additives to minimize their consumption is emphasized. Controlling food additives usage through necessary government legislations would be more effective.

KEYWORDS: *E numbers, Food additives, MSG, Knowledge, Perception*

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1. INTRODUCTION

1.1 Food additives and their uses

Food additives are substances added to food to or improving safety, freshness, taste, texture, or appearance (World Health Organization 2018). Their role in food supply is so important nowadays that it would not be possible to maintain the current selection, transportation and quality of food without food additives (Emerton & Choi 2008).

Food additives are used in food technology to preserve or obtain a certain consistency or appearance (Christensen et al. 2011). Some of them are animal or plant- derived, however, most are synthetic (World Health Organization 2018). Food additives are added in small quantities and are considered to be safe. Food additives have many benefits, such as increasing food safety and greater choice of food products etc. Food additives are classified as preservatives, antioxidants, flavorings, stabilizers, thickeners and dyes. Salt, sugar, vinegar, sodium benzoate or benzoic acid, sodium nitrate or nitrite and sulphur dioxide are preservatives. These preservatives are added to salted fish, jams, sources, burgers, fruit juices and pickles. The main antioxidant food additives are ascorbic acid (vitamin C), alpha-tocopherol (vitamin E), sodium citrate, butylated hydroxyanisole and butylated hydroxytoluene. They are added to margarine, fruit juice, vegetable oil and cooked meat. Monosodium glutamate (MSG), aspartame and synthetic essences are commonly used as flavor enhancers for many processed foods. Examples of stabilizers are lecithin, mono- and diglycerides of fatty acids. Stabilizers are used in food which contains oil and water, such as margarine, butter, ice cream and salad creams (mayonnaise). Examples of thickeners include modified starch, pectin, gelatin xanthan gum etc. They commonly used in jams, jelly, yoghurts, wine, chewing gum etc. Many food dyes are azo compounds or triphenyl compounds. Azo dyes produce red, orange and yellow, whereas triphenyl dyes produce blue and green colours in food (Types of food additives and their functions 2020).

Preservatives and anti-oxidants increase the durability of food by inhibiting or preventing unfavorable microbiological, chemical and biochemical changes. Anti-oxidants reduce the speed of oxidative reactions of food nutrients and prevent the degradation of free radicals into volatile odour substances (Zielinski & Kozlowska 2000). Stabilizers prevent an emulsion from separating out. Dyes are used to adding or restore the colour, enhancing its visual appeal to match consumers' interests. Nutrient additives replace vitamins and minerals that are lost in processing and add nutrients that may be lacking in the diet (International Food Information Council and U.S. Food and Drug Administration 2010).

1.2 Adverse effect of food additives

Though food additives are usually added in small quantities (Seetarmaiah et al. 2011), all food additives that are currently in use have been found to cause health problems (L**e**gesse, Muluken & Getasew 2016). Allergies, hormone imbalances, cancers, fertility problems, obesity and hyperactivity, are some of the main reported hazards of food additives (Christensen et al. 2011). Increased in nitrates due to food additives has been

found to cause increased deaths from Alzheimer's, Parkinson's and type 2 Diabetes (Anand & Sati 2013). Synthetic sweeteners and colorants cause neoplastic lesions and teratogenic effects (Zielinska & Czerwionka 2008). Many additives may cause skin allergic reactions or food allergies in sensitive individuals (Zielinska & Czerwionka 2008). Therefore, food additives are considered unnatural, unhealthy or even a public health risk (Bearth, Cousin & Siegrist 2014).

1.3 Safety evaluation of food additives

The World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) is responsible for assessing human health risks from food additives. Risk assessments of food additives is conducted by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) (World Health Organization 2018).

1.4 Related studies

A study conducted in Turkey has attempted to identify the level of knowledge of consumers about food additives through a survey. This survey was conducted in the centre of Tekirdag province in 2015 with 300 participants. The results of the study have revealed that there was a significant correlation between having sufficient knowledge about food additives and the profession of the respondents (Kayısoglu & Coskun 2016).

The knowledge and safety perception of urban women consumers on food additives has been tested in Chennai city, India. Three hundred urban women (25-50 years old) were recruited for this research using simple random sampling. The study has assessed consumers' knowledge about food additives, safety perceptions and frequency of consuming foods containing artificial additives. Results showed that less educated women had less knowledge about food additives. It has been further revealed that advertisements play a major role in influencing the usage of foods with additives (Infana & Vigasini 2015).

A case study conducted in Ethiopia attempted to identify consumers' awareness of health problems of food additives in packaged foods in 2013. Two hundred and seventy-nine employees participated in the study. Results have shown that 64.15% of respondents are aware of health problems of packaged foods that contain food additives. However, the majority of the respondent (70.96%) still want to consume packaged foods. This study has indicated the lack of knowledge among consumers about the chemical properties of food additives (L**e**gesse, Muluken & Getasew 2016).

Another study conducted in 2011 reported that consumers were very concerned about the colorants and artificial sweeteners in foods. In this study total of 430 consumers living in Seoul, Korea, have, participated. More than two-thirds expressed that information on food additives was insufficient. They attributed this lack of information to difficulties understanding the subject of food additives and insufficient education and public relation. That study also evaluated the impact of information transmission using matched pre- and post-surveys. Overall knowledge scores improved from 67.3% to 91.9% before and after the campaign. The pilot pre and post survey results implied that safety perception of

food additives was affected by consumer awareness and knowledge (Shim et al. 2011).

A survey conducted in Manritius also reported that most respondents had poor knowledge of food additives. A significant relationship has been shown between the level of education and knowledge rating based on percentages of correct answers to food additives (Koyratty & Aumjaud 2014).

An interventional study was conducted to improve consumer recognition and awareness of food additives through consumer education in South Korea in 2014, with 2782 participants. Before intervention, many consumers reported having poor knowledge of food additives. However, the awareness of food additives and safety has improved from 33.1% to 78.6% after intervention (Lee et al. 2014).

As indicated above, research have been conducted in many parts of the globe to assess the consumer's knowledge of food additives. Many of them have reported insufficient knowledge of consumer on food additives. To the best of our knowledge, no such studies have been conducted in Sri Lanka. This study was conducted to investigate the knowledge and perception of food additives in a group of consumers in the Galle municipal area, Sri Lanka. The study hypothesized that the knowledge would be inadequate. The specific objectives were to assess the consumer's knowledge of food additives, to compare the sectorial differences in the level of knowledge on food additives in different educational, economic-and social groups and to assess the consumer's perception of food additives. The research findings will be useful in making necessary recommendations of public awareness on food additives.

2. METHODOLOGY

2.1 Study design, study setting and sample size

This study was a descriptive cross-sectional study conducted as a community-based study in Galle Municipal. The sample size was calculated using the following formula **(**Pourhoseingholi, Vahedi & Rahimzadeh 2013**).**

$$n = \frac{p(1-p)\times z^2}{d^2}$$

n – Sample size, p –the expected proportion of subjects with the characteristics, d – margin of error, Z – standard normal deviate for the chosen confident level

The chosen confidence level is 90%, and Z was 1.96. The precision (d) is taken as 0.05, and p as 0.25 from the previous study (Kayısoglu & Coskun 2016). The calculated required sample size was 288. With the addition of 10% (29) to cater for the non-respondent, we recruited 317 for the study. However, 305 respondents completed the questionnaire. Individuals were aged 30-50 years of different educational, economic and social strata in the Galle municipal area were recruited for the study.

2.2 Subject recruitment criteria

The following inclusion and exclusion criteria were used for subject recruitment.

Inclusion criteria

- 30-50 years old individuals who live in Galle municipal area.

- Individuals who are willing to participate.
- Individuals who can read and write in Sinhala.

Exclusion criteria

- Consumers who are not willing to participate.
- Consumers who recite outside of the Galle municipal area.

2.3 Data collection

A self-prepared questionnaire (based on the literature review) was used to collect data and was pre-tested using 10 volunteers in Galle municipal area, in a pilot study. The same inclusion and exclusion criteria were adopted for selecting subjects for the pilot study and was conducted at MOH office, Galle municipal council, by self-administering the questionnaire to the volunteers. The length of the questionnaire, language comprehension, the ambiguity of words, misinterpretations, sensitivity of questions, or inability to answer and the practical issues were assessed during the pilot study. Modifications were done accordingly, and the final questionnaire was prepared and printed.

The questionnaire consisted of four main sections; parts A, B, C and D. Part A consists of 7 questions to obtain demographic data, including participant age, gender, educational level, occupation, monthly income etc. Part B consists of 21 questions of fundamental knowledge on food additives. Part C consists of 16 questions on the perception of food additives, and part D consists of 19 questions on knowledge of monosodium glutamate.

Ethical approval was sought from the Ethical Review Committee of the Faculty of Allied Health Sciences, University of Ruhuna. Institutional permissions were obtained from the Regional Director of Health Service in Galle district, General Managers of Chas P. Hayleys & Co. Ltd, Galle and Divisional Secretary of Galle Divisional Secretariats. Informed written consent was obtained from all participants after informing the purpose and the research methodology. Three hundred and seventeen eligible participants were recruited for the study at MOH offices in Galle municipal area, Divisional Secretariat, Galle and Chas P. Hayleys & Co. Ltd., Galle. These two institutions were combined with the MOH offices to recruit more participants of the target age group. A self-administered questionnaire was used for data collection. Most of the data were collected by visiting the MOH clinics in Galle. Selected institutes were visited on working days and questionnaires were distributed to the persons who fulfilled the inclusion criteria. The above institutes were revisited until obtaining the desired sample size.

2.4 Data analysis

Distribution of data used to find mean, median and percentages etc. using MS. Excel and Statistical Package for Social Sciences (SPSS), version 22.0. Statistical tests such as the chi-square and ANOVA were used to find the associations and mean differences wherever necessary. $p<0.05$ was considered statistically significant.

3. RESULTS AND DISCUSSION

There were no published data regarding consumers' knowledge and perception of food additives in Sri Lanka. Some related studies on knowledge and perception of

food additives have been done in other countries. This study assessed consumers' knowledge and perception of food additives. The study sample was 305 consumers aged 30-50 years in Galle Municipal.

The response rate of the study was 100%. Of the sample, 238 (78.0%) were females. The majority (87.2%) were Sinhalese, and 12.8% of respondents were from other ethnicities. The educational level of the majority (44.9%) was up to GCE advanced level. Of the sample, 25.2% were graduates. The majority of the participants (41.0%) were professional employees. The socio-demographic characteristics of the sample are indicated in table 1.

Table 1: Socio-demographic characteristic of the study sample

Characteristics	Percentage (%)
Age	
30-35 years	46.2
36- 40 years	28.2
41-45 years	11.8
46-50 years	13.8
Gender	
Male	22.0
Female	78.0
Ethnicity	
Sinhala	87.2
Tamil	0.7
Muslim	12.1
Other	-
Education level	
Under grade 5	0.3
Grade 5 – 11	11.8
Up to O/L	17.7
Up to A/L	44.9
Graduates	25.2
Occupation	
Un-employed	37.7
Trained worker	11.8
Un-trained worker	1.0 5
Businessmen	8.5
Professional employees	41.0

n=305

Knowledge scores of the study participants were calculated and categorized into three levels: below 50 into poor knowledge, 50-75 into average knowledge and above 75 into good knowledge. This mark categorization was decided by the researcher considering the length of knowledge assessed by the questionnaire since the literature did not support finding suitable categorization. The sample's mean (±SD) knowledge score was 39.8 (±19.1). Among the participants, 73.7% (n=225) were in poor knowledge level, 20.7% (n=63) were an average knowledge level, and only 5.6% (n=17) were in good knowledge level regarding food additives.

Similar results have been published in a study done in Turkey by Kayisoglu & Coskun (2016). This study was conducted using 300 participants in the centre of Tekirdag province. The majority of the participants (29.3%) were with faculty level education, and about 11% were graduates. According to their findings, the majority (63%) of the respondents had poor knowledge of food additives, and only 37% of respondents had sufficient knowledge. A study conducted at the University of Manritius has also found that overall, respondents had poor knowledge of food additives. The sample of this study is a working population in the above university (Koyratty & Aumjaud 2014).

All participants (n=305, 100%) have heard about food additives. 54.8% (n=167) of participants think they have sufficient knowledge about the food

additives. The majority (78.9%) of participants knew why additives are added to foods. Out of them, the majority (n=206, 67.5%) believed that additives are added to food to increase flavor, and 154 (50.5%) respondents said that it is done to maintain the appearance and texture of foods. About 46.8% of participants stated that food additives are used for storing foods for long times, and only 29.8% knew that food additives prevent microbial and chemical changes. Only fourteen (4.6%) respondents knew that food additives could be used to increase the nutritional value of foods. They had poor knowledge about other properties of food additives. Participant knowledge of food additives is presented in table 2.

A Turkish survey conducted with the participation of 300 people reported that reasons for using food additives as to store the foods long time (93.3%), to obtain good taste and aroma (69%) and to obtain shape and colour (63.7%) (Kayisoglu & Coskun 2016). Another study conducted with the participation of university employees has also indicated the lack of knowledge among consumers about the chemical properties of food additives (L**e**gesse, Muluken & Getasew 2016).

Table 2: Participants knowledge on food additives

Questions Response		Frequ-ency	Percen-tages
Know why additives are added to the food	Yes	235	77.0 %
	No	31	10.2 %
	No idea	32	10.5 %
	Did not respond	7	2.3 %
To prevent microbiological and chemical changes	Correct	91	29.8 %
	Incorrect	15	4.9 %
	Did not respond	199	65.3 %
To increase food flavor	Correct	206	67.5 %
	Incorrect	2	0.7 %
	Did not respond	97	31.8 %
To maintain and improving appearance and texture	Correct	154	50.5 %
	Incorrect	5	1.6 %
	Didn't respond	146	47.9 %
To store the food for long Time	Correct	143	46.8 %
	Incorrect	9	3.0 %
	Didn't respond	153	50.2 %
To increase nutritional value of foods	Correct	14	4.6 %
	Incorrect	59	19.3 %
	Didn't respond	232	76.1 %

In the present study, fewer 110 (36.1%) participants were aware of the "E" number of foods. Only 52 participants (17.0%) of the sample knew that the E number represented food additives and safety approval. The majority (n=250, 82.0%) did not know that the E number represents the food additives and safety approval.

According to a study done by Kayisoglu and Coskun (2016) in Turkey they had found that 26.3% of participants were aware of the E number. Only 52 (17%) participants had mentioned the correct definition of the E number as a number for the safety approval of food additives. Only 12.1% of participants had known the correct place where the E number is mentioned in food additives. In Chennai, India, a study found that 62.7% of women respondents do not know the "E" number (Irfana & Vigasini 2015).

The majority of the participants in the present study (n=274, 89.8%) believed

that food additives could affect their health. Tables 3 indicate the participants' knowledge on the effects of food additives on health.

Table 3: Knowledge of the participants on the effects of food additives on health

Question/statement	Response %		
	Yes	No	Did not respond
What are the effects of food additives?			
Food allergy	65.2%	1.3%	33.4%
Cancer	89.2%	1.3%	9.5%
Obesity	65.2%	0.3%	34.4%
Weight loss	28.2%	7.2%	64.6%
Increase absorption of vitamin and Minerals	7.9%	16.4 %	75.7%
Neurological diseases	56.7%	1.6%	41.6%
Cardiovascular diseases	70.2%	1.6%	28.2%
Fertility problems	64.9%	1.3%	33.8%
Hormone imbalance	64.2%	2.0%	33.8%
Asthma	32.5%	6.2%	61.3%

In a similar study conducted in Turkey, 74% of participants mentioned that food additives are not safe (Kayisoglu & Coskun 2016). In the present study majority (89.2%) said that cancer is the main effect of food additives, and other effects mentioned were cardiovascular diseases (70.2%), food allergy (65.2%) and hormone balance disturbing (64%). Another European study has reported that people were aware of the risk of developing allergy (75%), hormone balance disturbing (70%) and risk for cancers (60%) related to consumption of food additives (Christensen et al. 2011).

The majority of the present study participants (67.9 %) said they do not add food additives when preparing food. About 23.6% of participants mentioned that they add food additives when preparing foods. Soup cubes are the most common (22.3%) type of substance they added. The majority (58.0%) used food additives to increase the taste. Table 4 indicates the commonly used food additives at home and the reasons for their use.

About 7.9% of respondents used Ajinomoto (MSG) in food preparations. The study conducted by Irfana and Vigasini (2015) in Chennai, India found that 23.6% of participants were using MSG.

Table 4: Types of food additives commonly used at home and the reasons for their use

Questions	Response %		
	Yes	No	Did not respond
Types of substances with food additives frequently use at home			
Soup cubes	22.3	-	77.7
Ajinomoto (MSG)	7.9	-	92.1
Colorant	6.9	-	93.1
Gelatin	5.2	-	94.8
Sauces	5.2	-	94.8
Reason of using food additives during food preparation			
To increase taste	58.0		42.0
To improve appearance	15.1	0.7	84.4
To improve, maintain shape	9.2	0.7	90.1
To maintain texture	15.4	0.3	84.3

To prevent microbial attack	10.2	0.7	89.1

About 71.2% of the participants said they did not frequently consume packet foods and 24.5% of participants said they consume different packet foods frequently. The main reason for using packet foods was an easiness of eating. A similar study has reported that 71.68% of respondents did not frequently consume packet foods, and frequent consumers of packed foods, 15.5% of respondents said that reason is easier to manage (L**e**gesse, Muluken & Getasew 2016).

About 79.3% (n=242) mentioned that they have the habit of reading food labels, and 19.3% (n=59) participants mentioned that they do not read food labels. Of the participants, about 46.6% were reading the food labels always.

A study conducted by the University of Manritius revealed that 65% of all respondents never checked food labels for additives (Koyratty & Aumjaud 2014). Another study has found that the habit of reading food labels among participants is 70.3%, and it has shown a significant association with gender. Ladies tended to read food labels than gentlemen (Kayisoglu & Coskun 2016).

In this study, 99% of participants knew about Ajinomoto. However, only 34.4% of participants knew Ajinomoto refers to Mono Sodium Glutamate (MSG). About 52.1% of participants knew that it is flavor enhancer. About 6.9% of participants knew that MSG has an E number, and only 4 (1.3%) participants mentioned the correct answer. The majority (56.1%) of the participants did not consume foods with Ajinomoto. About 7.9% of participants said they use Ajinomoto at home during food preparation. About 38.7% of participants have heard about the adverse effects of MSG**.**

As determined by One-way ANOVA, there was no statistically significant difference between knowledge score and age categories [f (3,301) = 0.615, p = 0.606]. According to independent sample t-test there was no statistically significant difference of knowledge score between gender t (303) = -1.157, p = 0.248, and ethnicity t (303) = - 0.735, p = 0.463.

The knowledge scores of the respondents of different educational levels were significantly different. The graduates' knowledge score was significantly higher compared to the participants who learned up to O/L (44.1±20.0 vs 33.9±16.9, p=0.001).

A similar finding has reported in a study done in Chennai, India, revealing that women with lower education had poor knowledge about food additives (Irfana & Vigasini 2015). A study conducted at the University of Manritius also found a significant relationship between level of education and knowledge on food additives (Koyratty & Aumjaud 2014).

The knowledge scores of the respondents of different occupations were significantly different as determined by One-way ANOVA. Knowledge score was significantly higher in the professionals compared to the non-professional workers (p=0.012)

This study found that there was an association between usage of food additives and ethnicity (chi-square, x^2, df = 9.420, n = 298, p = 0.009), and educational level (chi-square, x^2, df = 11.750, n = 298, p = 0.019). Chi-square test was applied to assess the association between the habit of reading food labels

and education level. There was not found association between the habit of reading food labels with education level (chi-square, x^2, df = 6.518, n = 304, p = 0.164) and ethnicity (chi-square, x^2, df = 1.492, n = 304, p = 0.474). An association was found between habit of reading food label and gender (chi-square, x^2, df = 6.906, n = 304, p = 0.032).

There was no significant association between usage of Ajinomoto at home during food preparing with education level (chi-square, x^2, df = 8.086, n = 303, p = 0.088) and between usage of Ajinomoto at home during food preparing and ethnicity (chi-square, x^2, df = 7.469, n = 303, p = 0.024).

The knowledge score of the respondents regarding MSG was significantly higher in graduates compared to those who learned up to O/L (19.0±16.4 vs 34.2±23.6, p=0.001). Similarly, the knowledge score regarding MSG was significantly higher in professional workers compared to unemployed respondents (31.9±22.8 vs 22.0±19.9, p=0.001).

Limitations of the study

The present study was carried out on the consumers in Galle municipal area. Therefore, it is not appropriate to extrapolate results for the whole Sri Lankan population.

This study was planned to collect data from people who prepare meals and buy foods from markets. Therefore, the sample included the 30-50 years age group only.

4. CONCLUSIONS AND RECOMMENDATIONS

Overall knowledge of most consumers regarding food additives is poor irrespective of their education or background. However, graduates and professional employees show a significantly higher knowledge of food additives than consumers with lower educational levels, unemployed persons and non-professional workers. Usages of food additives showed differences with ethnicity. Muslim and Tamil consumers are using more food additives than Sinhalese. Females have the habit of reading food labels than males. The majority are not educated about the ‘E’ numbers of foods. A considerable portion of the study participants was using food additives during home meal preparations.

Results of the present study provide a factual basis for the urgent requirement of reviewing and revising the current food legislation in Sri Lanka and developing effective public education strategies to ensure food safety and improve the public's awareness of food additives.

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