Assessment of Quality Parameters of Locally Manufactured Yogurts in the Coastal Area of Ampara District

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Abstract- *Yogurt is a highly nutritious fermented dairy product that is widely popular among Sri Lankans due to its numerous health benefits, including the prevention of high blood pressure, easing the gastrointestinal problems, and weight control. As a result, there has been a rise in the number of yogurt consumers. No any updated and significant research on the quality parameters has been carried out. Hence, the current study is aimed to determine the compatibility of some quality parameters with specification for yogurt as per (SLS 824:2018) and to educate and promote the local manufacturers to comply with it. Samples of three different local manufacturers were collected from markets. Quality parameters such as, pH, fat, solid-non-fat (SNF), moisture and titratable acidity (TA) were determined with standard methods. The mean pH, fat, SNF, moisture and TA contents were found to be ranged from 4.49±0.016 - 4.63 ± 0.010, 0.10±0.00 - 0.36±0.20%, 21.6±0.530 - 25.81±0.08%, 73.73±0.15 - 78.13±0.35% and 0.11±0.00 - 0.426±0.08% respectively. All samples were found with lower moisture, TA and fat contents (81%, 0.6% and 3.0%) respectively, and higher SNF (8.0) while similar pH (4.5) to (SLS 824:2018). SNF, TA, fat and moisture contents were significantly varied ($p<0.05$) whereas no significant variation ($p<0.05$) was observed in pH value with (SLS 824:2018). There is room for local manufacturers to improve their whole production processes scientifically and provide quality products on par with (SLS 824:2018) to the local consumers.*

Keywords: SLS standard, solid non- fat, titratable acidity, yogurt

I. INTRODUCTION

Yogurt, on the other hand, has a composition that is very similar to milk. It is high in milk proteins and other nutrition (Weerathilake et al, 2014). It is a healthy and delicious food, which consumption has increased over the last decade in Sri Lanka, due to its high nutritive and therapeutic value (Perdigon *et al*, 2002 and Hemamali *et al*, 2016). It can also be prescribed to those with lactose intolerances, gastrointestinal illnesses (bowel illnesses), and weight loss due to its excellent digestion and bioavailability of nutrients (Lourens and Viljoen, 2001; Mckinley, 2005). Yogurt consumption is expanding due to the health benefits associated with it, and it is the fastest growing dairy category in the market specially, set yogurt and yogurt drinks (National Yogurt Association, 2013). Yogurts are probiotic carriers and they have a mildly sour taste with smooth texture, aroma and pleasant flavor (Mckinley, 2005). Yogurt improves the overall quality of the diet while also boosting the possibilities of meeting nutritional recommendations such as Recommended Dietary Allowances (RDA) for each nutrient daily (Weerathilake *et al*., 2014). According to World Health Organization (WHO), per capita milk consumption should be 200 ml per day per person and in 2020, the total annual milk production was estimated to be 491,538,618 liters (Department of Census and Statistics, 2020). However, the milk consumption in Sri Lanka is just more than 50% of what is required. Dairy market growth has been steady in recent years, indicating an upward trend. Yogurt is one of the most popular dairy products in Sri Lanka, accounting for more than 80% of the overall dairy market (Institute of Certified Management Accountants of Sri Lanka, 2017). As variety, just a few flavored products such as vanilla, strawberry, treacle, chocolate, fresh fruits and jelly yogurts are available in the markets. Furthermore, when compared to stirred yogurt, set yogurt is highly demanded in Sri Lanka (Institute of Certified Management Accountants of Sri Lanka, 2017). Adjusting the initial milk composition, pasteurizing the yogurt mix, fermenting at thermophilic temperatures (40-45^{0}C), cooling, and adding fruits and tastes are all part of the overall yogurt production process flow (Weerathilake *et al*., 2014).

According to earlier studies, yogurt was consumed by 96 % of households in various districts of Sri Lankan. (Diwuldeniya and Weligamage, 2015).

Hence, yogurt shall be prepared in accordance with the requirements laid down in the Sri Lanka Standards for yogurts (SLS 824:2018) to assure its health benefits and microbial safety, as well as consumer acceptability and preference (Hemamali et al., 2016). The Sri Lanka Standard Institution also explain legally recognized standards of quality, safety, composition, packaging, and labeling for food goods suitable for the Sri Lankan market (Weerasekara et al., 2010). Lack of information on the quality parameters of yogurts manufactured in Ampara district put the consumers on peril of health issues and the question arises whether the products meet the value for the money consumers paid for it. Therefore, it is necessary to evaluate the quality characteristics of locally manufactured yogurts.

II. LITERATURE REVIEW

The word "yogurt" comes from Turkish and refers to a fermented milk product produced by bacterial fermentation of milk (Ranasinghe and Perera, 2016). The general process flow of yogurt production includes adjusting the original milk composition, pasteurizing the yogurt mix, fermenting at thermophilic temperatures (40-45^{0}C), cooling, and adding fruits and flavors (Weerathilake *et al.*, 2014). Among the many dairy products on the market, yogurt is the most common product. It has the potential to be a low-cost and high-impact tool for helping individuals in underdeveloped nations to improve their nutritional status and health (Hattingh, 2001 and Al-Otaibi, 2009). Traditional culture yogurt and bio or probiotic yogurt are the two varieties of yogurt. *L. bulgaricus* and *S. thermophilus* are used to make standard yogurts. Although these bacteria are not said to live in the gut, they are capable of encouraging the friendly micro flora already present in the gut, assisting in the preservation of overall intestinal health (Dowden, 2013).

In addition to the traditional yogurt organisms; *S. thermophilus* and *L. bulgaricus*, some yogurt products have recently been reformulated to incorporate live *Lactobacillus* strains, such as *L. acidophilus*, and *Bifidobacterium* species (Nwamaka and Chike, 2010). Consumption of probiotics, which are live microbial supplements with presumed health benefits on human physiology, has become widespread. Probiotic bacteria increase the makeup and function of the gut microbiota while also boosting the immune system. Furthermore, vitamin synthesis has been recognized as one of the causal linkages of probiotic health effects (Hemarajata, and Versalovic, 2013).

Yogurt is rich in protein that contains all of the essential amino acids required for good health, a rich source of carbohydrate and contains a highly bioavailable source of calcium and also it contains source of phosphorus and potassium, riboflavin (B2), niacin (B3), as well as vitamin A and vitamin B12 (Weerathilake *et al.*, 2014). Observational studies and meta-analyses have found favorable relationships between yogurt consumption and risk factors for cardiovascular disease. Regular consumers of low-fat yogurt were 31% less likely to develop high blood pressure than those who consume it infrequently, according to research from the US Framingham cohort. It was once considered that eating a lot of yogurt could help with blood pressure regulation and may potentially help avoid hypertension (Wang *et al*., 2013).

III. PROBLEM STATEMENT

Many researchers in different districts of Sri Lanka have reported on the evaluation of yogurt quality parameters (Hemamali *et al*., 2016 and Weerasekara *et al*., 2010). However, no recent research has been conducted significantly on the quality parameters of yogurts manufactured in the coastal area of Ampara district; Kalmunai, Akkaraippattu and Pottuvil. Therefore, the present study aims to measure the gap between the values of some selected quality parameters of yogurts with the specification laid down in SLS 824:2018 so as to educate the manufacturers to comply with it and the consumers to select quality products as well.

IV. METHODOLOGY

A. Sample collection

Yogurts manufactured from three different local manufacturers were purchased as samples from markets representing the coastal area of Ampara district. The storage conditions, physical appearance and the shelf life of samples were considered as pre-requisite and get confirmed at the time of purchasing. All the samples were kept in a polystyrene ice box at 4 ^{0}C immediately after purchasing and brought to the laboratory for further analysis. Five individual number of yogurts cups from a manufacturer were purchased

and tested for all five cups individually as replicates. Then five replicates of testing were performed for each sample.

B. Analysis of quality parameters

The pH values were determined at 27°C with a benchtop pH meter (Starter 3100, OHAUS, USA) and moisture contents were determined with oven drying method to a constant weight using a dry oven (Memmert UF110, Germany). The fat contents were determined with Soxhlet system (FAT-06A) and the titratable acidity was determined with titrimetric method. The difference between the percentage of total solids and the percentage of fat contents were used to calculate the total solids-non-fat (SNF). All of the above determinations were carried out as per described in Association of Official Analytical Chemists (AOAC, 2005).

C. Statistical analysis

The data were analyzed with ANOVA at 95% confidence level. All the analyses were performed using SPSS 25 version.

V. RESULTS AND DISCUSSION

Three different brands of locally manufactured samples were analyzed. The results obtained from the analyses on moisture content, pH, titratable acidity, fat and solid non-fat are shown in Table 1.

Table 1: Results of quality parameters of local samples

Yogurt samples	pH	Fat (%)	Solid non-fat (%)	Moisture (%)	Titratable acidity (%)
Brand 1	4.63 ± 0.010	0.29 ± 0.137^{a}	25.82 ± 0.083^{d}	73.73 ± 0.151^{a}	0.43 ± 0.08^{b}
Brand 2	4.50±0.016	0.10 ± 0.002^{a}	21.60 ± 0.530^{b}	78.13 ± 0.353^{c}	0.12 ± 0.008^{a}
Brand 3	4.57±0.015	0.36 ± 0.205^{a}	23.04 ± 0.241^{c}	76.50 ± 0.153^{b}	0.19 ± 0.053^{a}
SLS Standard	4.50	3.00^{b}	8.00^{a}	81^{d}	0.6^{d}

Means ± SD within the same column with different superscripts are significantly different at $p<0.05$

A. Determination of fat content

The fat content in milk can be influenced by genetics, breed, diet used to feed the animal, and disease circumstances. Fat content of yogurt samples was found to be ranged from 0.10 - 0.36%, which were found to be lower than what is pacified in SLS 824:2018 and it could be one or many reasons such as genetic breed, diet used to feed the animal, and diseases (Weerasekara *et al*., 2010). Generally, low-quality milk contains low fat content (Weerasekara *et al*., 2010) and therefore great concern should be taken when the raw materials being purchased especially raw milk. According to USDA (2001), yogurt with less than 0.5% fat content should be labeled as "non-fat yogurt," those with fat levels between 0.5 - 2.5% should be called as "low fat yogurt," and those with fat content greater than 3.25% should be labeled "yogurt" (USDA, 2001). According to the results obtained in this present study, all yogurts samples could be termed as “non-fat yogurt” due to less fat content (below 0.5%). A significant difference ($p<0.05$) in fat contents was found to be observed between the local samples and that of the requirements prescribed in SLS 824:2018. Meanwhile, no significant variation was observed within the local samples. A study conducted in the North Central regions revealed that the fat content of yogurt was not up to the specification prescribed in SLS 824:2018 and that the fat percent by mass in most of the samples was below the required amount (Weerasekara *et al*., 2010).

B. Determination of pH Content

The pH values of all local samples were found to be more and less similar when compared to the requirements of pH value (4.5) specified in SLS 824:2018. Improper fermentation and time interval of storage that occurred further microbial fermentation causes higher pH value (Ali *et al*., 2002; Rashid and Miyamoto, 2005). The pH values of all the samples were found to be non-significant ($p>0.05$) when compared to the requirement prescribed in the respective SLS

standard. According to research conducted in Sabaragamuwa province of Sri Lanka, the pH of locally manufactured yogurts ranged from 3.97 - 4.10, and it was not higher than the SLS standard (De Silva and Rathnayaka, 2014).

C. Determination of Solid-Non-Fat (SNF)

SNF contents in milk can also be influenced by the genetics, breed, feed that used to feed animal and disease conditions (Weerasekara *et al*., 2010). As far as the yogurt production is concerned, in addition to fat content, determination of SNF content also one of the important parameters. According to the results of this present study, SNF was nearly three times higher than that of the requirements of SLS standard (8.0%) and it was found to be significantly varied (p<0.05) between the local samples and the SLS standard. Maximum SNF percentage was found to be observed in a local sample (25.81%). It is obvious that the drastic increase in SNF content was due to the reason of adulterating the milk to increase the consistency of the milk so that to increase the thickness of the yogurts. According to a study conducted in Sabaragamuwa province, SNF of locally manufactured yogurts ranged from 13.5 - 26.54, which was greater than the SLS standard and there was no any significant variation was observed among collected sample (De Silva and Rathnayaka, 2014).

D. *Determination of moisture content*

Moisture content of yogurt samples was found to be varied between 73.73 - 78.13%, which were found to be less than that of the requirements prescribed in SLS 824:2018 (81%) and a further significant difference was observed (p<0.05) within the local samples and between the requirements prescribed in SLS standards 824:2018. According to the study of Laxminarayana *et al.* (1952) the moisture content should be 85-88% for whole milk yogurt, but during the production of yogurt, producers used to add milk powder to increase the concentration of yogurt which gives more firmness to the yogurt. The variation in moisture contents between different local samples could be caused by over ripening and also being used more cultures than required (Saiful Bari *et al*, 2015).

E. Determination of Titratable Acidity (TA)

The maximum TA value was found to be observed in a local sample (0.42%) and minimum was found to be in another sample (0.116%). The Highest acidity value of yogurt might be due to improper incubation and prolonged storage while the lowest value of yogurt samples might be produced under controlled incubation and temperature (Saiful Bari *et al*, 2015). Titratable acidity values were found to be lower than that of the standard value and found to be observed significant (p<0.05) variation with the requirement of SLS standard value of 0.6%.

VI. CONCLUSION

According to the findings of this present study, all three local varieties were found to be of high quality in terms of SNF content; however, in terms of moisture, titratable acidity and fat contents, all three samples were found to deviating from the requirement of SLS standard. So, those parameters could be maintained by way of practicing proper yogurt manufacturing standards procedures and adapting suitable quality control activities of the local manufacturers. Due to a lack of information on the quality parameters of yogurts manufactured in Ampara district, the consumers are clueless over the quality and consistency of locally manufactured products and also the consumers are at a peril of health risks and the question arises whether the product meets the value for the money paid for it. Therefore, it is highly recommended to the local manufacturers to comply with the relevant standards so as to supply products on par with the standards.

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