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COMPOSITIONAL QUALITY OF MILK SOLD AT URBAN SALES OUTLET

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ABSTRACT: A study was conducted to determine the compositional quality of milk sold at urban sales outlet. A total of 40 random samples each were collected from the outlet of the study locations. The samples were analyzed using ultrasonic milk analyzer, Lactoscan MCCW, Milktronics Ltd (Bulgaria). All samples were measured and taken in triplicate for fat, protein, lactose, salts, density, solids not fat (SNF) and added water. Analysis of Variance was run to determine if the means of milk samples collected from different sales outlet are significantly different. The results indicated that mean fat, protein and lactose compositions were found to be highest from the milk sampled from Darla sales outlet (5.51%) when compared to other study locations. Significant differences ($p < 0.05$) were found in the mean fat composition of the milk between Darla – Haa and Kuruthang – Haa sales outlet. Likewise, significant differences ($p < 0.05$) on mean protein composition were observed in the sampled milk from majority of study locations. Moreover, significant differences ($p < 0.05$) on mean lactose composition were also noted from majority of the study locations. The study also indicated a high incidence of water addition in milk with adulteration of samples ranging from 52.5% to as high as 92.5%. The adulteration takes place across value chain by key actors right from processing point to sales outlet. This has largely compromised the compositional quality of milk and could pose a public health hazard. Thus, it is imperative that proper mechanisms such as educational advocacy to key dairy value chain actors and regulations be instituted to prevent such fraudulent practices.

Keywords: Adulteration; compositional; market milk; value chain.

1. INTRODUCTION

Milk production in the country stands at 57,546 MT in the year 2019 which has increased by 1,959 MT from 2018 (Department of Livestock [DoL] 2019). In the year 2019, the country also produced 2,126 MT of butter, 4,090 MT of cheese and 182 MT of chugo. Majority of the milk produced by the farmers enter into dairy value chain and ultimately reaches to the consumers across the country. The value chain features the predominant use of middlemen in the supply of milk and milk products from production areas to the market. The increase in production of milk and milk products has be accompanied by appropriate good manufacturing practices and essential quality controls along the value chain to ensure supply of good quality products to the consumers.

However, at the moment, majority of milk is adulterated one way or the other thereby compromising the quality and the safety. Nyokabi et al. (2020) defines milk adulteration as the alteration of the natural composition of milk by (i) the extraction of one or more of its components, such as fat, or (ii) the addition of substances such as water by value chain actors. Adulteration interferes not only with the compositional and processing quality of milk, but also the hygienic and nutritional quality, while extraction of milk components lowers the value-for-money of milk purchased by processors and the consumers. Shaikh et al. (2013) reported that adulteration of milk occurs through the addition of water and removal of cream or a combination of both and was predominantly practiced by the middlemen acting as milk suppliers/dealers. He also observed that an unorganized and non-regulated marketing system does not offer the opportunity to improve the quality of milk for consumers. Similarly, Azad et al. (2016), found that motivation for food fraud is economic but the impact is of real public health concern. The author added that the situation is significantly worse in developing and underdeveloped countries due to absence of adequate monitoring and lack of proper law enforcement. Handford et al. (2016) reported that milk fraud has become a reoccurring problem in developing countries due to the lack of awareness by food safety authorities. One of the easiest methods to commit fraud is by addition of water to milk. Furthermore, if the water is contaminated with chemical or biological hazards, this will further increase the risk to the consumers. This was further supported by Kandpal et al. (2012) who found that one of the oldest and simplest forms of milk fraud is through the addition of variable volumes of water to artificially increase its volume for greater profit. However, this can substantially decrease the nutritional value of milk, and when the water added is contaminated then there is a risk to human health because of potential waterborne diseases.

The findings on market milk analysis for Thimphu and Paro Dzongkhags highlighted that the average composition of market milk in Thimphu was 3.72% fat, 2.40% protein, 3.59% lactose and an added water content of 21.04% while the average composition of market milk in Paro was 3.82% fat, 2.76% protein, 4.14% lactose and an added water content of 8.16%. The findings emphasized consistent water adulteration in milk sold to consumers with considerable variation in milk components (Norbu et al. 2020). This adulteration with water will not only pose a risk to human health through the use of non-potable water but will also affect the overall compositional quality of milk. Till date, in-depth studies to draw better science-based inferences on the compositional quality of market milk at the national level have not been carried out. Thus, this study was designed to investigate the compositional quality of milk sold through urban sales outlet across various districts.

2. MATERIALS AND METHODS

2.1 Study areas

The study was carried out in Bajo (Wangduephodrang), Kuruthang (Punakha), Darla (Chukha), Gelephu (Sarpang) and Haa.

2.2 Data collection and analysis

In total, 40 random samples each were collected from milk sales outlet in Bajo, Kuruthang, Darla, Gelephu and Haa for the analysis. The compositional analysis of samples was carried out using ultrasonic milk analyzer, Lactoscan MCCW, Milktronics Ltd (Bulgaria). All samples were measured and taken in triplicate for fat, protein, lactose, salts, density, solids not fat (SNF) and added water. The milk samples were analyzed descriptively using SPSS Version 21.0. The Analysis of Variance was also administered to determine if the means of milk samples collected from different sales outlet are significantly different.

For purposes of this study, milk obtained from the farm of the National Dairy Research and Development Centre, Yusipang was used as a reference sample. The composition analyzed at the centre was 4.7% fat, 3.4% protein, 4.6% lactose, 0.7% salts and a freezing point of -0.550.

3. RESULTS AND DISCUSSIONS

The mean milk compositional quality from different sales outlet is presented in Table 1. The mean fat composition was found to be highest from the milk sampled from Darla sales outlet (5.51%) and lowest from Haa (4.50%). Likewise, protein composition was highest from the milk sampled from Darla sales outlet (2.94%) and lowest from Bajo (2.49%). Moreover, the lactose content was also found to be highest from the milk sampled from Darla (4.38%) and lowest from Bajo (3.70%).

The added water content was found highest from the milk sampled from Bajo sales outlet (16.90%) with a freezing point of -0.431°C and lowest from Darla with 2.39% added water and a freezing point of -0.519°C. A significant difference ($p < 0.05$) was found in the mean fat

Table 1: Mean (± SD) milk composition for the different study locations

Location	N	Fat	Protein	Lactose	Freezing Point	Added Water
Bajo	40	5.04±1.11	2.49±0.27[a]	3.70±0.37[a]	-0.431±0.04[a]	16.90±9.04[a]
Darla	40	5.51±0.89[ac]	2.95±0.23[bd]	4.38±0.24[bde]	-0.519±0.03[bd]	2.39±4.61[bde]
Gelephu	40	5.06±0.95	2.76±0.14[ce]	4.16±0.22[bc]	-0.486±0.02[ce]	6.75±4.89[ce]
Haa	40	4.50±0.76[b]	2.92±0.18[bde]	4.37±0.21[bd]	-0.510±0.02[bde]	3.14±3.56[bde]
Kuruthang	40	5.17±0.70[ac]	2.82±0.17[cde]	4.22±0.21[bcde]	-0.496±0.02[cde]	5.20±4.83[bcde]
Total	200	5.06±0.94	2.79±0.26	4.17±0.36	-0.488±0.04	6.88±7.71

The different superscripts within the column indicate significant differences ($p<0.05$)

composition of the milk between Darla – Haa and Kuruthang – Haa sales outlet. The mean fat composition in the other study areas did not show any significant difference. In general, the milk fat content of all milk sampled was found to be within acceptable range in comparison to the reference milk fat of 4.70%.

The mean protein composition from sampled milk showed significant differences ($p < 0.05$) amongst majority of the study locations (Table 1). The protein composition of all samples was found to be below the expected reference value of 3.40% with results ranging from 2.49 to 2.95%. Significant differences ($p < 0.05$) were found for the mean lactose composition from the sampled milk from majority of the study locations (Table 1). The mean lactose content from all study locations was lower than the expected reference value of 4.60%.

Significant differences ($p < 0.05$) were also found for added water content in the sampled milk amongst study locations with Bajo sales outlet recording the highest mean added water content at 16.90% while Darla recorded the lowest added water content at 2.39%. Similarly, significant differences ($p < 0.05$) were also observed for the freezing point in majority of the sampled milk in the study areas with an average mean freezing point of -0.488°C which is far above the expected reference value of -0.550°C. Meredith et al. (2007) reported that the osmotic pressure of a cow's milk can only vary by narrow limits, and it follows that the salt balance of her milk (freezing point) can only vary by narrow limits. On the other hand, Barham et al. (2014) assessed that milk containing extraneous water will have a grossly elevated freezing point. Norbu et al. (2020) reported the average composition of milk in Thimphu Dzongkhag as 3.72% fat, 2.40% protein, 3.59% lactose, -0.411°C freezing point and added water content of 21.04% while composition of milk from Paro Dzongkhag was reported as 3.83% fat, 2.76% protein, 4.14% lactose, -0.478C freezing point and 8.16% added water. The findings on the compositional quality of milk from the study locations averaged to 5.06% fat, 2.79% protein, 4.17% lactose, -0.488C freezing point and 6.88% added water. Thus, all compositional parameters except for fat content were found below the reference composition of milk.

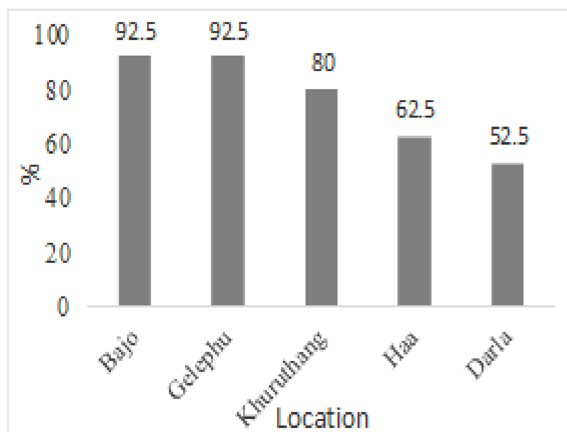

Figure 1: Extent of water adulteration

The highest water adulteration in the milk (Figure 1) was observed in the samples analyzed from Bajo and Gelephu sales outlet with 92.5% of them adulterated followed by Kuruthang with 80%, Haa with 62.5% and Darla with 52.5%. Memon et al. (2018) reported reduction in fat, protein and lactose content in milk that are adulterated with 10% and/or 20% water. These findings are in line with the observations in the study location with bigger compositional changes occurring with higher percentage of added water. The presence of extraneous water as observed by various authors change the normal compositional parameter and reduces the nutritional value of milk thereby posing a public health risk through the addition of contaminated water. Handford et al. (2016) evaluated that due to the dilution of various nutrients within milk, fraudsters use various materials to increase the nutritional value making it difficult to detect. Most commonly, milk powder, urea, cane sugar, melamine, formalin, caustic soda and detergents are used by the defaulters to increase the nutritional value in milk. However, it was beyond the scope of the current study to assess the fraudulent practices to increase the nutritional values in milk.

4. CONCLUSION

Adulteration of milk with water has been found in all the study areas. This is the areas of great concern as the consumers are being supplied with inferior quality milk. Further, such adulterated milk could directly compromise the quality and also pose a public health hazard. The use of unclean or contaminated water provides a medium for the growth of microbes in the milk. Moreover, the processing of such inferior quality milk will also result in low quality dairy products and the proliferation of microbes will drastically reduce the shelf life of the products. In order to curb such un-healthy practices, it is imperative that appropriate measures and regulations are put in place across dairy value chain. The producers, processors, middle men and retailers are required to be sensitized on the importance of producing and supplying good quality, unadulterated milk to the consumers. Instituting proper educational advocacy and regulations with constant monitoring by the relevant regulatory agencies across the dairy value chain is important in order to effectively control such fraudulent practices.

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