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Evaluation of Physicochemical Properties and Sensory Qualities of Raw Milk Collected from Lactating Cows Fed on Different Level of Peanut Meal

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Abstract

The study was conducted to evaluate the feeding value of Peanut Meal (PM) with concentrate feeds on milk physical quality and milk composition. Changeover design was used in three periods each comprising 25 days plus the first seven days for adaptation and ten days for wash out residual effect between consecutive periods. Treatment diet was PM while Soya Bean Meal (SBM) was used as control leveled at a ratio of 100PM: 0SBM (T1), 50PM: 50SBM (T2) and 0PM: 100SBM (T3). The basal diets were maize, wheat bran, minerals and vitamin premix while grass hay and corn silage were fed ad libitum. Results of analysis of chemical composition of milk shows that there was highly significant difference ($P<0.05$) in milk fat due to treatments and stages of lactation (3.52, 3.59 and 3.65) for T1, T2, T3 and (3.58). The CP% of milk was different among treatments (3.6, 3.61 and 3.63 of T1, T2 and T3, respectively. Result of Sensory evaluation of milk showed significant difference only in color. Generally, the experiment showed that replacement of peanut meal for soybean meal has improved the milk qualities. Therefore, I recommend peanut meal for dairy producer to use as a supplement.

Keywords: Milk composition • Milk yield • Milk quality • Peanut meal • Soy bean meal

Introduction

Agricultural sector is the pillar of Ethiopia's economy, and livestock is an important component of it. With an estimated 70 million cattle, 42.9 million sheep, 52.5 million goats, 2.15 million horses, 10.8 million donkeys, 0.38 million mules and 8.1 million camels, Ethiopia boasts Africa's biggest livestock population. Food products of animal origin play an important role in sufficient and balanced nutrition of human beings. Milk and milk products are among the most important food products of animal origin. Milk a is biological fluid secreted by the mammary glands of female mammals. It supplies of nutrients needed for the growth, maintenance, production, and correct functioning of the bodies of mammals. It is the natural product attained from the emission of the mammary gland of lactating animals. It is a very wholesome matter, which comprises macro and micronutrients such as proteins, carbohydrates, vitamins, minerals and active compounds having a role in health protection. Milk fat and lactose are vital bases of energy. Cattle milk is highly used produce worldwide followed by that of goat and camel milk. In Ethiopia, cows donate about ninety five percent of the entire yearly milk manufactured in the country. Milk is a multifarious organic fluid and by its nature helps as a worthy development medium for many microbes, because of its high-water content, nearly neutral pH, and diversity of accessible vital nutrients. Most milk consumed by humans is typically obtained from cow [1].

Raw milk is a highly fragile and helps as the best growth intermediate for pathogens as it has ideal pH, high water and nutrients component. The daily production of a perishable commodity with high water content strains special reflection to ensure its arrival to market in an acceptable condition. If the aseptic standards of production and handling are deprived, the keeping quality of milk would be very low due to the high ambient temperatures and there will be a very high risk of putrefaction. Milk protein, fat, and lactose are an important source of energy. One gram of milk fat gives 9.3 Cal and one gram of protein and lactose gives 4.1 cal. In Ethiopia, 95% of milk has occurred from cattle, and Cow milk is the utmost used up in the world followed by that of goat, camel and donkey. The quality and the composition of milk are very important to the dairy industry and human health because milk composition is related to milk process ability. Milk quality refers to a mix of chemical, physical, bacteriological, and cosmetic features that improve the acceptability of the milk product, whereas milk protection refers to the absence of pathogenic organisms and other contaminants that could be harmful to the consumer's health. The specific gravity, chemical makeup, and microbiological condition of milk determine its consistency and protection. The content and chemical composition of milk products are critical variables in influencing their quality and protection [2].

The quality of fresh milk has paramount importance for the quality of by products of its origin; consequently, quality of raw milk must be controlled correctly. Safety of dairy goods with respect to food-borne syndromes is of great concern of the Global community. This is especially true in developing countries where production of milk and various dairy products take place under rather unhygienic circumstances and humble production practices. Haramaya University is the top performing university in Ethiopia where so many employees are wishing to live. As a result, there is high demand for dairy products in general and for fresh milk in specific. Though studies related to evaluation of quality and safety of milk and dairy products are extensively conducted in here, milk quality requires frequent evaluation and quantification. The need for the up –to-date evidence associated with fresh milk quality and dairy products is of very important. Therefore, the aim of this study was to evaluate the physicochemical properties and sensory qualities of raw cow's milk produced in Haramaya University [3].

Objectives

General objectives: To evaluate the hygienic practices and chemical

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compositions of milk fresh milk.

Specific objectives: To evaluate the hygienic practices of raw cow milk

To evaluate chemical compositions of milk fresh milk

Materials and Methods

Description of study area

The study was conducted at Haramaya University Dairy Farm, which is located in Haramaya district in the eastern Hararghe Zone of Oromia Regional State, Ethiopia, 500 km east of Addis Ababa, the capital city of the country. Astronomically the University is located at 9° 26' N latitude and 42° 3'E longitude with altitude about 2000 meters above sea level. The mean annual rainfall of the study area is about 870 mm, which ranges 560-1260 mm, and the mean maximum and minimum temperatures are 23.4°C and 8.25°C. The area receives bimodal distribution rainfall pattern, peaking in mid-April and mid-August. There are four seasons, as a short rainy season (mid-March to mid-May), a short dry season (end of May to end of June), a long wet season (early July to mid-October) and long dry season (end of October to end of February). Main pasture production obtained after the short rainy season, continuing until the end of the long wet season [4].

Management of study animal

Fifteen Lactating pure Holstein Friesian dairy cows were selected from Dairy Farm of Haramaya University and classified based on their lactation stages. Cows between 7 to 105 days of delivery were classified as early, between 106 to 210 days as mid and those in between 211 to 315 days under late stage of lactation. All cows were taken from the same parity (parity one). The cows were offered daily rations 0.5 kg/liter as equal meals three times per day at 6:00 am; 2:00pm and 10:00 pm with equal interval of 8 hours and provided free access to water and space. Corn silage and grass hay were offered ad libitum as a main roughage source. Cows were milked two times per day at 06:00 am in the morning and 4:00pm in the afternoon. Selected animals have initial body weight of 428 ± 3.33kg (Mean ± SE) (Table 1).

Concentrate feed, which contains mixtures of wheat bran, ground corn, salt dicalcium phosphate and minerals and vitamin premixes after formulation with the help of NRC (2000 software), were included to the experimental diet to form total mixed ration. The experimental rations were given for the animals before milking (during afternoon time), after milking (during morning time) and at the night with respective treatment. Corn silage and grass hay was offered ad libitum to the animals with the concern of 60:40 concentrate to forage ratio so that the rumen microorganisms function properly [5].

The experimental period was divided in to three and the experimental feeds were randomly assigned to each subject. Each period has twenty-five days and between each consecutive period, ten days of washout period were settled to avoid carry over effect (residual effect of the treatment). Milk Samples were taken three times after the 21st days of each period for analysis of milk composition. Measurements which were taken during the washout period were not used for analysis. To control the effect of the order of applying treatments, subjects were often randomly assigned to cows of early lactation, mid-lactation and late lactation. Cows in early lactation received treatment one, mid lactating cows on treatment two and late on treatment three during period one. In period two, cows in early lactation fed treatment two, mid-lactation received treatment three and cows in late lactation received treatment one. During period three early lactating cows received treatment three, mid lactating cows on treatment one and late lactating cows were fed on treatment two. In general the experiment was conducted during dry season starting from December 2017-March 2018 [6].

Physical quality of milk

Sensory evaluation: Sensory characteristics of milk samples were evaluated for different sensory attributes by a group of seven semi-trained panelists who were selected purposefully based on their previous experience and skills from the staff and students of Animal and Range Sciences School. All panelists shared the same room of uniform condition and no any disturbance like music, sound or extreme light doesn't present. For every parameter, 80ml of pasteurized milk sample was given for each panelist. The panelists were provided purified bottle water to rinse their mouth in between each mouth fill milk test. Sensory attributes like colour, odor, taste and overall acceptability for all samples were assessed using seven point hedonic scales. Hedonic scale was in the following sequence: like very much -7, like moderately -6, like slightly -5, neither like nor dislike -4, dislike slightly -3, dislike moderately, -2, dislike very much -1 [7].

Temperature and pH: The pH of the milk sample were determined in the laboratory using a digital pH meter, while temperature of the sample was determined at the laboratory soon after arrival by using Thermometer.

Titratable acidity: Titratable acidity of collected milk sample was determined according to the method of Association of Analytical Chemistry. Nine ml of milk sample taken in to the beaker and three to four drop of 1% phenolphthalein indicator was added to it. The milk sample was then titrated with a base (0.1NaOH) until the faint pink color occur. By recording the volume of base required to change the color of milk to pink and the volume of the milk sample, titratable acidity expressed as the percentage of lactic acid. Phenolphthalein indicator solution (0.5% in 50% ethanol alcohol) prepared by dissolving one gram of phenolphthalein in 100 ml of 95 percent ethyl alcohol.

$$Titratable\ Acidity = \frac{\frac{N}{10}(ml)(0.009)}{weight\ of\ sample} * 100$$

N=Normality of the standard sodium hydroxide solution,

Chemical composition of milk

Daily milk yield recorded throughout the experimental periods at each morning and afternoon milking. Milk samples were collected on the last three consecutive days of each experimental period (23rd, 24th and 25th) days for determining milk composition and the mean was taken for analysis. The reason why samples were taken on these days is that milk composition is affected by feed after twenty one days. Milk fat change can be expressed after seven to twenty one days by changing the diet of the cow while milk protein changes may take three to six weeks or longer if the problem has been going on for a long period [8]. Milk sample of 250 ml from each animal under different treatment was taken after through mixing. The collected milk samples were analyzed soon in the same day at Haramaya University Dairy Technology Laboratory for fat, protein, lactose, Solid Not Fat, Total Solid, Lactic Acid and Urea using Milk-Scan (FT1) machine. The ash content of milk was determined gravimetric method as described by AOAC (2000), using muffle furnace. Sample of milk dried in drying oven for 17hours at 105°C, ignited in Muffle Furness at 550°C for 4hrs.

$$\text{Ash\%} = \frac{weight\ of\ ignited\ sample}{weight\ of\ sample\ taken} * 100$$

Results and Discussion

The physical qualities of milk

The physical qualities of milk samples (Temperature, pH, Titratable Acidity and Sensory Quality). The result showed no significant difference in milk temperature. The highest Titratable acidity (0.16) was scored when cows fed on treatment one. The titratable acidity obtained from this experiment (0.145-0.16) was within the normal range of fresh milk (0.14-0.16). The current result reveals the pH-value of milk (6.58-6.67) was within the average pH-value of fresh milk (6.6-6.8. There was statistically significant difference ($P<0.05$) in milk color of cows due to treatment. The highest score was found in treatment one (6.37) which liked very much by the panelists. This agrees with the work of Hope and β-carotene. In addition to this Hope and tested that β-carotene release p-cresol which is responsible for barny aroma and may derive from deamination and decarboxylation of tryptophan and tyrosine [9,10]. This may

Table 1. List of percentage composition of experimental feed.

Treatments	% of Peanut Meal	% Soybean Meal	Order of Treatments
T-1	100%	0%	Period I=T1,T2, T3
T-2	50%	50%	Period II=T2,T3,T1
T-3	0%	100%	Period III=T3,T1,T2

Table 2. Mean value of physical properties and sensory qualities of milk.

Fixed Factors		Parameters			Sensory Qualities			
		pH	Tem	TA	Color	Smell	Taste	OAA
Period	I	6.58^{b}	25.84	0.15	6.20	6.10^{b}	6.00	6.16
	II	6.56^{b}	25.85	0.15	6.22	6.24^{a}	4.14	6.26
	III	6.80^{a}	25.86	0.16	6.19	5.90^{c}	6.10	6.00
Trt	1	6.63	25.84	0.16^{a}	6.37^{a}	6.05^{b}	6.05	6.12
	2	6.67	25.85	0.14^{b}	6.20^{b}	6.06^{b}	6.08	6.16
	3	6.66	25.85	0.15^{ab}	6.00^{c}	6.18^{a}	6.19	6.11

Means with different superscript letters in the same column are statistically different at P<0.05. OAA=Over All Acceptability

Table 3. Chemical compositions of milk.

Trt	Fat	Pro	TS	SNF	Ash	lactose	LA
T1	3.52^{c}	3.60	11.91	8.70	0.7	4.80	0.16
T2	3.59^{b}	3.61	11.90	8.60	0.7	4.82	0.15
T3	3.65^{a}	3.63	11.91	8.64	0.7	4.79	0.15
p-I	3.57	3.61	11.89	8.61	0.7	4.31^{b}	0.15
p-II	3.58	3.61	11.93	8.65	0.7	4.49^{a}	0.16
p-III	3.60	3.63	11.89	8.64	0.7	4.58^{a}	0.15

Mean values with different superscript letters in the same column are statistically different at P<0.05. Where: ADMY=Average Daily Milk Yield, LA=Lactic Acid, MY=Milk Yield, SNF=Solid Not Fat, Trt=Treatments, TS=Total Solids

be related to the feeding trend of the panelists as ground nut is commonly consumed in this area so that they might have been adapted to it and this may be the probable reason the panelist preferred the smell of milk obtained from cows supplemented with sole peanut meal. The Treatment and period has no significant effect on overall acceptability of milk. Diet, dietary supplementation, have an impact on the fatty acid composition of milk fat this may in turn affect the physical quality of milk because the aroma and the color are determined by milk fatty acid. Generally, the inclusion of peanut meal in the diets did not have negative effect on physical properties of milk (Tables 2 and 3).

Conclusion

Chemical composition of milk

The results of mean comparison of chemical composition of milk of lactating Holstein Frisian dairy cows fed on peanut meal and soybean meal with concentrate were presented. Milk fat, and lactose contents were significantly affected (P<0.05) while the remaining milk contents were not significantly (P>0.05) different among treatments. The results of the present study of milk composition and noted differences in milk composition under different concentrate feeding. Milk fat composition was affected by the amount and composition of dietary component. Higher fat and protein can be recovered in milk by feeding high forage diets or improving the energy. In general it can be concluded that supplementing cows with peanut meal has no effect on chemical composition of milk except fat content. The period has no significant effect on the chemical composition of milk except the lactose content. According to this experiment, the highest milk lactose (4.49 g/L) was found in period two and the lowest milk lactose (4.31) was scored in period one.

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Conflict of Interest

None.

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