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Composition of milk- A comparative analysis between indigenous and cross breed cows of Ganjam

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Abstract

The study was carried out in Berhampur city of Ganjam District from 03.10.2018 to 02.12.2018 to estimate the composition of milk in Cross breed and Indigenous breed cows. Twenty dairy cows with a standard body weight between 250 kg to 350 kg, 3rd to 7th lactation period and 5-7 years of age were taken for the study. Total Protein was determined by Nano spectrophotometer, Total Carbohydrates were determined by anthrone techniques, Acidity were determined by IS: 1479-1 (1960) and total casein was determined by Acid precipitation. Concerning the milk components, Cross Breed groups shows a significant variation (P< 0.05) attributed to type of feed and breed. The statistical analysis showed a significant increase (P<0.05) in protein, ASH and SNF percentage as compare to Indigenous breed. Total solid and Moisture of IB and CB groups has Non-significant increase (P< 0.5) in Cross Breed as compare to Indigenous breed. Fat content shows a Non-significant increase (P< 0.5) in cross breed cows than the Indigenous breed cows. Acidity% found highly significant (P<0.0001) in both breed of cows. Lactose content found a Non-significant increase in indigenous breed cows as compare to the cross breed cows (P<0.5). Lactometer reading shows significant increase (P<0.01) in Cross breed group of cows as compare to Indigenous breed cows. Specific Gravity found a Non-significant increase (P<0.1) in cross breed cows. Total Casein content found highly significant in cross breed cows (P<0.001).

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Introduction

Odisha is one of the least developed states in India. Odisha is one of the eastern states of India having tremendous agriculture and allied opportunity. Odisha has total land area of 1, 55,820sq.km with 30 districts having population of 4.19 Cr. Ganjam is one of the districts in Odisha where milk is very important in rural area. Odisha is not only a Poor state but also affected with malnutrition. Therefore efficient and effective production of milk can bridge the gap of mal nutrition in Odisha. Major problem of any type of agri-related activity is fragmented land. Apart from fragmentation of land, illiteracy, lack of information flow, lack of govt. Policy implementation, less credit facility, issue with marketing has resulted inefficient and less productive dairy sector. Mixed crop livestock farming is the most predominant farming system for over 80% of all rural households in the state. Milk is an ancient as mankind itself, as it is the substance created to feed the mammalian infant. All species of mammals from man to whales produce milk for this purpose. Milk is the characteristic secretion of mammary gland of all mammals. Because of its function of the nourishment of the young, it is necessarily complex; It must supply nutrients, minerals and vitamins in proper form, kind and amount (Roadhouse and Henderson, 1950).Milk is very complex naturally possessing many chemical and physical components. All milks contain the same kind of constituents but in varying amount. Within a given species, genetic factors and environmental conditions such as the climate and the stage of lactation influence the composition (Roadhouse and Henderson, 1950). According to Malcolm and Paul, cow milk contains 12.5% total solids, 3.8% fat, 8.7% solid not fat, 4.6% lactose, 0.8% ash, 0.2% NPN (nonprotein nitrogen), 3.1% protein and 87.5% water. Composition of milk is also strongly influenced by the breed of animals. It has been reported that breeds producing milk with a high fat content produce less milk then those with lower fat percentage (Castle & Watkin, 1979). Milk composition also varies with stages of lactation, during early stage of lactation that is colostral stage milk composition is considerably different. Colostrum is rich in antibodies and is different from normal milk in color & taste.

The free dictionary simply defines milk as a whitish liquid containing milk proteins, fats, lactose, and various vitamins and minerals, produced by the mammary glands of all adult female mammals after childbirth and serves as food for their young. It should be noted that milk culture is infused with the sanctity of the cow in ancient Egypt, Iran and India. In Europe, the monks, including the Benedictines in the middle ages were the main producers of cheese for example Bishop, Munster. Thus, before the scientific revolution and industrial development in Europe during the nineteenth century, were fabrications and techniques of fermented milk, butter and cheese already had a considerable importance in human life (Konte, 1999). The breeding of dairy animals dates back to nearly 8000 years and so has opened up opportunities to improve eating habits, especially for infant feeding, as it is a raw material in the dairy industry. Milk must be specific to human consumption i.e. come from well nourished healthy lactating animals. This means that the milk of infected animals (resulting from inflammation of the udder), undergoing a veterinary treatment is excluded. Milk should have a temperature of +4°C during all operations and delivery to the consumer (Kohler, 2013). We all as consumers and producers should know that the quality of the milk can be compromised by contamination and ensure proper handling, since it is a perishable material. Milk is the most complete food, rich in protein, carbohydrates, mineral, vitamin and calcium. In this review of literature, we recorded for the first time the composition of milk of different species, in terms of their principal components to know that milk supports human nutrition and is a product in the dairy and food industry. Given that some milk (e.g. cow and sheep milk) are promoted as a suitable alternative to breast milk and infant formula (Guetouache *et al.,* 2014).

There is a lot of interest in nutritional contribution of milk and dairy products to our diet, possibly due to diverging attitudes towards the relationship between their consumption and our health. On one hand they are high in saturated fatty acids (SFA) which might challenge health but they also supply

many unsaturated fatty acids and antioxidants, beneficial to our health1 and are a valuable source of quality protein, calcium and iodine. Modern, western diets have many weaknesses but whilst advice to cut total fat consumption will help reduce calories and the most harmful saturated fatty acids (C12:0, C14:0 and C16:0), it will also diminish lipid soluble beneficial nutrients like vitamins A and E as well as omega-3 fatty acids (n-3), already deficient in our diets. An alternative approach would be to alter the composition of the food on offer, reducing the proportion of SFA whilst enhancing the supply of monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) along with other beneficial nutrients (Butler *et al*., 2019).

The aim of the study is to compare the milk composition between Indigenous and cross breed of cows and to know the percentage of Proximate Parameters like Milk Yield, Total solid, Moisture, Fat, SNF, Acidity, ASH, Lactose, LR and Specific Gravity.

Materials and methods

Study Area

The study was carried out in Berhampur city of Ganjam district.

Procedure

Twenty Lactating cows from the above mentioned area are taken for the study {10 Local Breeds and 10 Cross Breed}. 10 Milk samples from both breeds were collected by direct milking. After collection of milk, samples were taken to the PG Department of Zoology, Berhampur University, Berhampur and Bhubaneswar OMFED DAIRY for compositional analysis

Analysis

Milk samples were analyzed both physically and chemically by following test.

- Determination of lactometer reading by Lactometer.
- Specific gravity by using Lactometer.
- Determination of Acidity by titratable acidity test.
- Estimation of Carbohydrates (Lactose) was done by Anthrone method
- Estimation of Total Protein by Nanodrop lite spectrophotometer.
- Determination of Fat by Gerber method.
- Determination of Ash by Furnace.
- Determination of Moisture by Oven drying.
- Determination of Total Solid by Gerber method.
- Determination of SNF by Gerber method.
- Measurement of Milk Yield by measuring cylinder.
- Estimation of Total Casein content by acid precipitation.

Result and discussion

Milk Yield

The variation of milk yield between indigenous breed and cross breed are shown in table. The result showed that milk yield was significantly increase ($P<0.05$), indigenous breed produced 3.7liter/day and cross breed produced 12liter/day (Table 1 & Fig. 1). This moral superiority in milk productivity recorded by cross breed cows compared to local breed under the same conditions was proved by many researcher (Ageeb and Hayes, 2000). According to Marphes (1964) and Castillo (2007), Oil seed cakes contains higher percentage of protein which increase milk production in dairy animals. Inclusion of concentrate increases the total milk production (Darwish, 2009). Cross breed cows produced more milk than indigenous breed. All milks contain the same kind of constituents but in varying amount within a given species, genetic factors and environmental conditions such as the climate and the stage of lactation which influence the milk composition (Roadhouse and Henderson, 1950).

Milk density measured by Lactometer

Table No. 1: Comparison of milk composition between indigenous breed and cross breed cows (Mean ± SEM). Numbers in parentheses indicates sample size, Significant (S), at 0.05 confidence level.

	Milk Composition					
	Milk yield	Fat	Acidity	Lactose	Total solid	S N F
Indigenous Breed	3.68 ± 0.1 (-10)	3.15 ± 0.1 (-10)	0.12 ± 0.001 (-10)	5.03 ± 0.07 (-10)	10.95 ± 0.21 (-10)	8.34 ± 0.03 (-10)
P Value	P < 0.05	P < 0.5	P < 0.0001	P < 0.5	P < 0.5	P < 0.05
Cross Breed	11.9 ± 0.4 (-10)	4.8 ± 0.1 (-10)	0.12 ± 0.005 (-10)	4.13 ± 0.09 (-10)	13.85 ± 0.18 (-10)	9.6 ± 0.07 (-10)
F Value	0.24	0.4	0.04	0.71	1.56	0.26

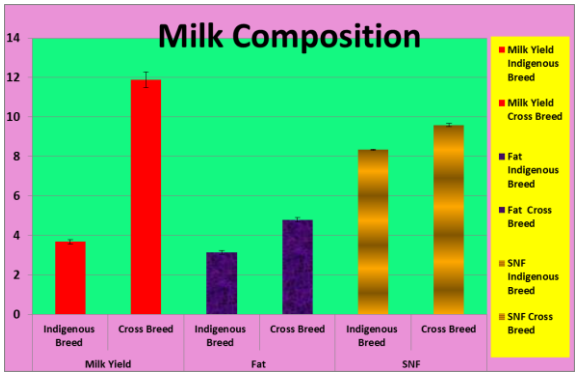

Fig. 1: Comparison of milk composition (Milk yield, FAT and SNF contents) between indigenous breed and cross breed cows. Columns represent the mean values and vertical bars SEM

Milk Fat

The results of chemical analysis of the Fat content between IB and CB cows were found to be Non-significant (0.5). Milk fat composition was affected by the amount and composition of dietary components (Palmquist *et al.,* 1993). Genotype had a significant effect on all milk production parameters, high merit cows had the highest yield of milk, Fat, Protein and lactose where as low merit cows had the lowest milk, fat, Protein and lactose concentration (Kennedy *et al.*, 2003). Cross breed recorded highest percentage of Fat in Milk (4.8%) as compare to Indigenous breed (3.1%). (Table 1 & Fig. 1)

Total Protein

The current study showed significant increase (P <0.05) in protein content. Cross breed cows had the highest milk protein (6.56%) than local breed (5.06%) (Table 2 & Fig. 3). The protein content is an important feature of milk. The TP determines the market value of milk, the higher the TP value is compared to a reference, the more money the producer will get. Milk proteins represent 95% of crude protein but the remaining 5% is free amino acids, small peptides and nonprotein nitrogen (Guetouache *et al.,* 2014).

Nanodrop lite Spectrophotometer

Table No.2: Comparison of milk composition between indigenous breed and cross breed cows (Mean ± SEM). Numbers in parentheses indicates sample size, Significant (S), at 0.05 confidence level.

	Milk Composition					
	Moisture	Total caisen	Total protein	L. metre reading	Specific gravity	ASH
Indigenous Breed	85.95 ± 0.02 (10)	4.89 ± 0.06 (10)	5.06 ± 0.12 (10)	28.9 ± 0.34 (10)	1.02 ± 0.003 (10)	0.75 ± 0.01 (10)
P Value	P < 0.5	P < 0.001	P < 0.05	P < 0.1	P < 0.1	P< 0.05
Cross Breed	88.75 ± 0.2 (10)	6.97 ± 0.15 (10)	6.56 ± 0.21 (10)	31.8 ± 0.46 (10)	1.03 ± 0.004 (10)	0.94 ± 0.008 (10)

Casein

The casein is a group name for the dominant class of protein in milk. Normal bovine milk contains about 3.5% protein in which casein constitutes about 80%. Casein is easily separated from milk either by acid precipitation or by adding rennin. Casein is dispersed in milk in the form of micelles. (Schmidt et al., 1988 and Robinson, 1981). The current study showed a significant increase (P<0.001) in total casein. Cross breed cows had the highest casein content (6.97) as compare to indigenous breed cows (4.89) (Table 2& Fig. 3).

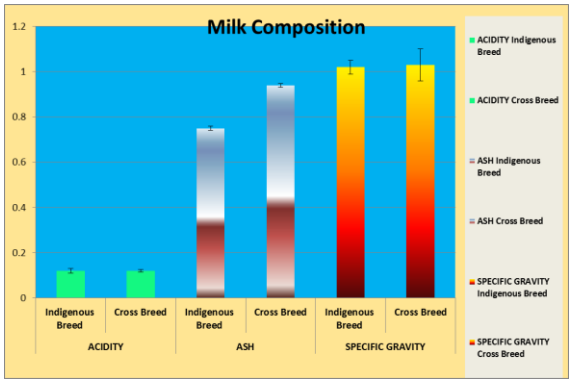

Fig. 2: Comparison of milk composition (Acidity, ASH and Specific gravity contents) between indigenous breed and cross breed cows. Columns represent the mean values and vertical bars SEM

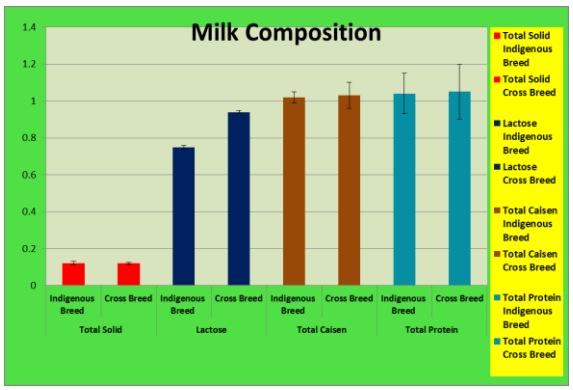

Fig. 3: Comparison of milk composition (Total solid, Lactose, Total casein and Total protein contents) between indigenous breed and cross breed cows. Columns represent the mean values and vertical bars SEM.

Carbohydrate (Lactose)

Lactose content found Non-significant increase (P<0.5) in cross breed cows as compare to local breed cows. (Table 1 & Figure 3).

The main carbohydrate of milk is lactose. It is usually prepared of two sugars (galactose and glucose). Average amount of milk lactose varies in between 4.7% to 4.9%. Mastitis reduces lactose secretion. It has significant role in the fermented of milk production. (Schmidt et al., 1988 and Robinson, 1981)

Total solid and SNF

The present study revealed a nonsignificant increase (p<0.5) in total solid content. Cross breed cows had the highest TS (13.85%) than local breed cows (10.95%). Total solids portion of milk without fat is called solid not- fat or SNF. The variations depend on lactation stage and seasons, even though other reasons has less important, just like conditions of the environment and animal breed etc. (Jones et al., 1957). The present study revealed a significant increase (p<0.05) between the two breed of cows in solid not-fat. Cross breed cows was the highest SNF (9.6) than local breed cows (8.34). (Table 1 Fig. 3 & Fig. 1)

Moisture and Ash Content

The results showed a Non-significant increase (P <0.5) of moisture content in cross breed cows. High moisture content is directly proportional to high water activity which in turn supports microbial growth consequently decreasing the shelf life of the milk sample and vice versa. Ash content varied significantly (p<0.05) between two breeds. When the water of milk or any other food is removed by evaporation and the dry residue is incinerated at a low red heat, there will be left a white or nearly white ash which contains the mineral substances. (Kanwal et al., 2004). The Ash contents varied from 0.75 to 0.94 respectively. (Table 2& Fig. 2 & Fig. 4)

Measurement of ASH.

Lactometer Reading and Specific Gravities

The result of LR and specific gravity of both breed of milk samples are shown in table. The CB cow's milk showed the highest LR and specific gravity i.e. 31.8 and 1.03. Similarly in IB cow's milk showed LR (28.9) and specific gravity (1.02). No significant difference (p<0.1) between two breed of cows (Table 2 Fig. 4 & Fig. 2).

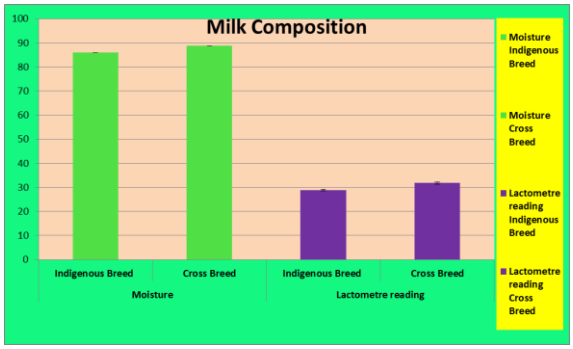

Fig. 4: Comparison of milk composition (Moisture and Lactometer reading contents) between indigenous breed and cross breed cows. Columns represent the mean values and vertical bars SEM.

Acidity

The milk is acidic and the avg. natural acidity is 0.13-0.14%. The pH is another measure of acidity and pH values of milk is 6.4-6.6. The acidity and pH of fresh milk varies with species, breed, individuality and stages of lactation and as well on health of animal. Acidity content found a significant result ($p<0.0001$) between the two breed of cows (Table 1 & Fig. 2).

Conclusion

Comparison of the proximate analysis of milk samples from two different breeds of cows has shown that cross breed cows hold a possibility of a better yield, as this local breed appears to be better dairy cattle than CB. It was found that by knowing milk composition, the farmers can give balanced diet to the animals for their growth and healthy development. Beside this, it is also good for the human consumption because human body already synthesizes carbohydrate, protein, fat in the form of glucose, amino acid and fatty acid. Human body needs vitamins and minerals. Milk is a nutrient rich and white liquid food which can be recommended for multi variety of health profit. If cow's milk contain excessive amount of nutrients, then it has adverse effect on human health. Excess amount of concentrate feed may also be an obstacle for the growth and development of the cows. Over consumption of few nutrients like potassium, phosphorus, calcium and lactose that present more in the milk, that will be able to harm kidney, artery or various visceral organs. So it is very essential to recognize the exact nutritional value in milk before it is consumed. It will be an excellent idea to ensure the levels of milk while searching for a healthy choice.

This study also reveals that, by knowing milk composition, the farmers can give balanced diet to the animals for their growth and healthy development. Beside this, it is also good for the human consumption because human body already synthesizes carbohydrate, protein, Fat in the form of glucose, amino acid and fatty acid. Human body needs vitamins and minerals. Milk is a nutrient rich and white liquid food which can offer a multi range of health benefits. If cow's milk contain excessive amount of nutrients, then it has adverse effect on human health. Excess amount of concentrate feed may also be an obstacle for the growth and development of the cows. Over consumption of few nutrients like potassium, phosphorus, calcium and lactose that present more in the milk, that will be able to harm kidney, artery or various visceral organs. So it is very essential to recognize the exact nutritional value in milk before it is consumed. It will be an excellent idea to ensure the levels of milk while searching for a healthy choice.

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