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Physicochemical, Minerals and Fatty acids of Cow's and Camel's Yoghurt

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Abstract: The main objective of this study was to evaluate the physicochemical, minerals and fatty acids of yoghurt as affected by milk source. Cow's and camel's fresh milk were collected from Khartoum University farm in clean and sterilized ice containers, filtered, pasteurized at 85^{o}C for 30 sec and then cooled to 42^{o}C. Starter culture MIX505LYODCU (*Streptococcus thermophilus* and *Lactobacillus bulgaricus* SSP.), Danisco, France was added at the level of 3% then, samples were incubated at 42^{o}C for four hours. After setting, yoghurt samples were then kept refrigerated at 4^{o}C for 24hrs. Physicochemical, minerals and fatty acids were determined using the standard analytical procedures. Statistically, Completely Randomized Design (CRD) in 2x2x3 factorial arrangement was used. The data collected were subjected to (ANOVA) using SAS software. The results shows that, milk source had insignificant (P>0.05) influence on chemical composition. Total solid of cow's and camel's yoghurt were 15.90 and 14.90%, respectively. Cow's yoghurt had protein content of 4.07%, while, camel's yoghurt had protein content of 3.19%. Milk source was no insignificant (P≥0.05) effect on fat content of yoghurt. Yoghurt made from cow's milk had a fat content of 3.61%, while, yogurt made from camel's milk recorded a fat content of 3.80%. Cow's yoghurt was higher lactose content 3.20% than camel's yoghurt 3.17%. There were significant (P<0.05) differences between ash content of cow's and camel's yoghurt. Calcium content of yoghurt was significantly (P≤0.05) affected by milk source. Camel's yoghurt was higher in calcium Ca^{++} content (137.67mg/100g) when compared to cow's one (124.33mg/100g). Regarding phosphorus P^{++} content of yoghurt, camel's yoghurt had higher phosphorus content 92.36mg/100g when compared to cow's one 87.33mg/100g. Camel's yoghurt had significantly (P<0.05) higher (79.10%) saturated fatty acids (SFA) when compared to cow's yoghurt (69.17%). Milk source showed no significant (P>0.05) effect on polyunsaturated fatty acid between cow's and camel's yoghurt. Cow's yoghurt had (3.50%) PUFA, while, camel's yoghurt had (3.53%) PUFA. Generally, camel yoghurt had contain more nutrients than cow's one.

Key words: Camel, Yoghurt, Minerals, Saturated fatty acids (SFA), Mono Unsaturated Fatty Acids (MUFA), polyunsaturated fatty acid (PUFA).

1. INTRODUCTION:

Livestock is the main agricultural resource in Sudan. Its population is more than 100 million heads, distributed throughout the country according to the climatic conditions (MLFR, 2020). However, milk production from these animals was estimated more than 4391.000 tons (MLFR,

2020). Generally, milk composition can vary for different reasons categorized into milk source, feeding design, seasoning, management system and environmental factors (Obi *et al.,* 2010). Cow's milk is a good source of protein, fat, calcium, lactose, minerals and vitamins (Ismaeil, 2018). Camel's milk plays an important role in the nutrition of camel herders in the arid and semi arid regions. The nutritional value of camel milk is basically related to its chemical composition (Mohamed and Larsson-Raznikiewicz, 1990). Camel's milk is different from other ruminant milk and it does not form coagulum in acidic environment (Wangoh, 1993). Thus, fermented camel milk products are difficult to produce because of the problem in milk coagulation. Mohamed and Larsson Raznikiewicz *et al.* (1990) found that camel milk coagulum failed to reach a gel-like structure even after 18 h incubation with lactic acid culture. Likewise, Jumah *et al*. (2001) study the effect of milk source including milk from ovine, caprine, bovine and camel on the rheological properties of curd during the gelation process of yogurt and found that the lowest value for viscosity was showed by yogurt made from camel milk. Consumption of dairy products had been associated with decreased risk of osteoporosis, hypertension, colon cancer, obesity and insulin resistance syndrome (IRS). The main dietary source of calcium and vitamin D are dairy products (Kosasih, 2011). Yoghurt is consider the one of dairy products and great source of health-promoting substances due to high levels of viable lactic acid bacteria content, which compete with several opportunistic microorganisms and provide desirable metabolites that contribute to consumer health (Park, 2007). In Sudan it is believed that yoghurt (zabadi) is useful for the treatment of stomach disturbances, and the individuals with such complaints are advised to take Zabadi (Dirar, 1993). Children suffering from infantile diarrhea recovered more rapidly when fed yoghurt than those given neomycin-kaopectatc (Shahani and Chardan 1979). Yoghurt can be produced utilizing milk from different milk types (Tamime and Robinson, 2007). Wherefore, this research aim to study the physicochemical composition, minerals and fatty acids of cow's and camel's yoghurt.

2. MATERIALS AND METHODS:

2.1 Materials:

Fresh cow's and camel's milk were obtained from Khartoum university farm and transferred immediately in sterilized container in an ice box to the Animal Products Department laboratory, National Food Research Center (NFRC). Starter culture MIX505LYODCU, freeze- dried form, Danisco France was obtained from a domestic dairy factory at Khartoum State. Backing materials were purchased from a local market in Omdurman city. Chemicals and reagents used

were obtained from the Lab line company-Khartoum. All the chemical and reagents were of analytical grades.

2.2 Methods:

2.2.1 Yoghurt manufacture:

Fresh milk was filtered through a sterilized cloth sheet. Samples were pasteurized at 85˚C for 30 seconds and left to cool down to 42^{o}C. Starter culture Yo-MIX505LYODCU was added at the level of 3% (w/v) containing a mixture of (*Streptococcus thermophilus* and *Lactobacillus bulgaricus*) at ratio of 1:1, then samples were incubated at 42^{o}C for about four hours. Samples were then kept refrigerated at 4^{o}C until needed.

2.2.2 Analytical methods:

2.2.2.1 Physicochemical analysis:

The Physicochemical was determined according to the standard method of the Association of Official Analytical Chemists (AOAC, 2005).

2.2.2.2 Minerals determination:

The Minerals determination was determined according to the standard method of the Association of Official Analytical Chemists (AOAC, 2005).

2.2.2.3 Fatty acids:

Fatty acids were determined according to the method used by Hammond (1986).

3. RESULTS AND DISCUSSION:

3.1 Chemical composition fresh cow's and camel's milk:

Table (1) shows the proximate analysis of fresh milk from two different sources. Generally, milk source had insignificant (P>0.05) influence on chemical composition of yoghurt. Cow and camel samples had similar (P>0.05) moisture content 87.47%. Eissa (2008) found that, cow's milk had moisture content of (87.60%), while camel's milk had a moisture content of (86.78%). Lee and Lucey (2010) reported that, cow's milk is composed of 88% water. Johnson (1980) found that, camel milk had moisture content of 87.21%.

Camel milk had higher total solids 11.60%, than cow's one 11.50%. Eissa (2008) found that, cow and camel milk had Total solids of 11.80 and 11.86%, respectively. Bano *et al.,* (2011) who found that, the total solids in cow's milk was 12.3%. Johnson (1980) found that, camel milk had total solids of 12.39%.

The results of protein content were (3.30% and 3.20%) for cow's and camel's milk respectively. The protein content of cow's milk was similar to that found by Bano *et al.* (2011) who reported a value of (3.30%). Johnson (1980) found that, camel milk had total solids of 12.39%.

Fat content of cow's and camel's milk were (4.03%) and (4.00%) respectively. Eissa (2008) reported that, cow's and camel's milk had fat content of (3.67%) and (3.18%) respectively. Bano *et al.* (2011) reported that, cow milk had fat content of 3.66%. Johnson (1980) found that, camel milk was 2.89% protein content.

Cow's had higher lactose content 4.20%, than camel one 4.17%. These results were similar to those found by Eissa (2008) who reported that, cow's and camel milk had lactose content of 4.20 and 4.16%, respectively.

Camel milk had higher ash content 0.80%, when compared to cow's one 0.70%. Similar result was reported by Johnson (1980) who found that, ash content of camel milk was 0.70%. DF (2004) reported that, milk mineral salts are mainly chlorides, phosphates and citrates of sodium, calcium and magnesium. Milk samples used in the study comply with the Sudanese standard specification of milk (SSMO, 2008).

The pH value of camel's milk was slightly lower (6.46) than that of cow's milk 6.57. The camel milk composition was on line with Anon (1980) who found that, the general composition of camel milk varies in various part of the world with a range of 3.07-5.5 fat, 3.5-4.5% protein, 0.7.0.9% ash, and 85.87-90% water. Generally, milk composition is affected by different factors; genetic factors, breed, stage of lactation, season and nutrition system (Dabora, 2016).

Table (1): Chemical composition of cow's and camel's milk

Parameters	Cow's Milk	Camel's milk
Moisture content (%)	87.47[a] (±0.05)	87.46[a] (±0.02)
Total solids content ((%)	11.60[a] (±0.01)	11.50[a] (±0.03)
Protein content (%)	3.30[a] (±0.03)	3.20[a] (±0.02)
Fat content	4.03[a]	4.00[a]

(%)	(±0.02)	(±0.03)
Lactose content (%)	4.20^{a} (±0.01)	4.17^{a} (±0.10)
Ash content (%)	0.70^{b} (±0.22)	0.80^{a} (±0.23)
pH	6.57^{a} (±0.02)	6.46^{a} (±0.02)

Values are means ± SD.

Means in the same row for the same parameter bearing the same letter are not significantly different (P≥0.05).

3.2 Physicochemical composition of cow's and camel's yoghurt:

Physicochemical composition of cow's and camel's yoghurt is illustrated in Table (2). Chemical composition of yoghurt was significantly (P<0.05) influenced by milk source. Total solid of cow's and camel's yoghurt were 15.90 and 14.90%, respectively. The higher total solids content of yoghurt made from cow's milk might be due to the higher total solids content of cow's milk (11.60%). Dirar (1993) stated that, total solids of raw milk that used in the production of yoghurt will affect the total solids percentage of the end product. Dabora (2016) reported that, cow's yoghurt had T.S of (15.04%). Eisaa (2008) reported that, camel yoghurt was total solids of 12.20%.

Cow's yoghurt had protein content of 4.07%, while, camel's yoghurt had protein content of 3.19%. Eissa (2008) found that, the milk source had insignificant effect on the protein content of yoghurt. Onimawo and Egbekun (1998) reported that, cow's yoghurt was protein content of 3.50%. Govol *et al*., (2004) stated that, the reduction in T.S during storage period of yoghurt and break down of amino acids by starter culture.

Yoghurt made from cow's milk had a fat content of 3.61%, while, yogurt made from camel's milk recorded a fat content of 3.80%. It was obvious that, milk source had no significant (P>0.05) effect on fat content of both yoghurt types. Ehirim and Onyeneke (2013) reported that, fat contents of cow's yoghurt were 2.85%. Moreover, lactic acid bacteria have a lipase activity that influences the fatty acid pattern (Mirghani, 1994).

Table (2) indicated that, no significant (P≥0.05) differences among the two samples. Cow's yoghurt was higher lactose content 3.20% than camel's yoghurt 3.17%. Eissa (2008) reported that, cow's and camel's yoghurt had lactose content of 3.60 and 3.40%. Higher lactose content of

cow's yoghurt 3.60% was found by Eissa (2008). Lower lactose content was found by Onyeneke (2013). Elhassan (2017) reported that, lactose sugar invert to lactic acid during storage period.

Data in Table (2) showed that, there were significant ($P<0.05$) differences between ash content of cow's and camel's yoghurt. The higher ash content 0.90%, was recorded for yoghurt made from camel's milk, whereas, the lower one 0.70%, was recorded for yoghurt made from cow's milk. Eissa (2008) reported that, cow's and camel's yoghurt had ash content of 0.66 and 0.70%.

Significant ($P\leq0.05$) differences of pH-values among the yoghurt samples. Cow's yoghurt was higher 4.37 pH value than camel's one 4.24. Similar observation was noticed by Eissa (2008) who reported that, camel's yoghurt was higher 5.11 pH value than cow's one 5.60. Codex (2003) reported that, the maximum pH value of yoghurt is (4.50) in order to prevent the growth of any pathogenic. Generally, milk composition is affected by different factors: genetic factor, breed, age, stage of lactation, season and nutrition system (Dabora, 2016). Furthermore, Deeth and Tamime (1981) stated that, the composition of yoghurt varies considerably according to the type of yoghurt manufactured and the composition of milk.

Table (2): Physicochemical composition of cow's and camel's yoghurt

Parameters	Cow's yoghurt	Camel's yoghurt
Total solids (%)	15.90^{a} (±0.02)	14.90^{b} (±0.12)
Protein (%)	4.07^{a} (±0.26)	3.19^{a} (±0.30)
Fat (%)	3.61^{a} (±0.01)	3.80^{a} (±0.02)
Lactose (%)	3.20^{a} (±0.01)	3.17^{a} (±0.03)
Ash (%)	0.70^{a} (±0.04)	0.90^{b} (±0.31)
pH	4.37^{a} (±0.01)	4.24^{b} (±0.01)

Values are means ± SD.

Means in the same row for the same parameter bearing the same subscript letter are not significantly different ($P>0.05$).

3.3 Mineral contents of cow's and camel's yoghurt:

Data in Table (3), show the effect of milk source on minerals content of yoghurt made from cow's and camel's milk. Calcium content of yoghurt was significantly ($P \leq 0.05$) affected by milk source. Camel's yoghurt was higher in calcium Ca^{++} content (137.67mg/100g) when compared to cow's one (124.33mg/100g). Lower calcium content of yoghurt was 118.70 mg/100g, reported by Dabora (2016). Bano *et al.,* (2011) reported that, calcium content of cow's yoghurt was (293.8mg/100g).

Regarding phosphorus P^{++} content of yoghurt, camel's yoghurt had higher phosphorus content 92.36mg/100g when compared to cow's one 87.33mg/100g. Dabora (2016) found that, phosphorus content of cow's yoghurt was 94.84mg/100g.

There was no significant ($P \geq 0.05$) difference among yoghurt samples in iron contents. Cow's and camel's yoghurt iron contents were 0.37mg/100g and 0.32mg/100g, respectively. The current results were higher than that reported by Wabil (2008) who found that, iron content of cow's yoghurt was (0.23mg/100g). Bano *et al.,* (2011) reported that, Fe^{++} content in cow's yoghurt was found in greater amounts compared to cow's milk.

Table (3): Mineral contents of cow's and Camel's yoghurt

Minerals content (Mg/100g)	Cow's yoghurt	Camel's yoghurt
Calcium (Ca^{++})	124.33^{b} (±0.02)	137.67^{a} (±0.04)
Phosphorus (P^{++})	87.33^{b} (±0.01)	92.36^{a} (±0.21)
Iron (Fe^{++})	0.37^{a} (±0.42)	0.32^{a} (±0.49)

Values are means ± SD.

Means in the same row for the same parameter bearing the same subscript letter are not significantly different ($P>0.05$).

3.4 Fatty acids composition of cow's and camel's yoghurt:

Results in Table (4), summarizes the fatty acids composition of cow's and camel's yoghurt. It was evident that, camel's yoghurt had significantly ($P<0.05$) higher (79.10%) saturated fatty acids (SFA) when compared to cow's yoghurt (69.17%). Svetlana *et al.,* (2011) reported that, the sum of SFA of cow's yoghurt was (69.87%). Higher SFA was found by Jandal (1996). Lindmark Mansson (2003) stated that, saturated fatty acids present in milk accounts for approximately 70% by weigh. These variations in SFA could be attributed partially to breed differences, fat composition of raw materials and lactation stage.

Apart from SFA, milk source significantly ($P<0.05$) influenced the Mono Unsaturated Fatty Acids (MUFA). Cow's and camel's yoghurt were found to have MUFA of 22.37% and 21.02% respectively. Svetlana *et al.,* (2011) reported that, cow's yoghurt had MUFA content of 25.11%. Lower MUFA was obtained by Jandal (1996). Lindmark Mansson (2003) stated that, approximately 25% of the fatty acids in milk are mono-unsaturated.

Milk source showed no significant ($P>0.05$) effect on polyunsaturated fatty acid between cow's and camel's yoghurt. Cow's yoghurt had (3.50%) PUFA, while, camel's yoghurt had (3.53%) PUFA. Jandal (1996) reported that, cow's yoghurt had PUFA content of 5.92%. Lindmark Mansson (2003) stated that, bout 2.3% by weight of the total fatty acids and the main poly-unsaturated fatty acids are linoleic acid (18:2) and a-linolenic acid (18:3) accounting for 1.6 and 0.7% by weight of the total fatty acid. These variations in PUFA could be attributed partially to species differences, fat composition of raw milk and lactation stage.

Table (4): Fatty acids composition contents of cow's and Camel's yoghurt

Fatty acids composition %	Cow's yoghurt	Camel's yoghurt
Saturated Fatty Acids (SFA)	69.17^{b} (±0.11)	79.10^{a} (±0.02)
Mono-unsaturated Fatty Acids (MUFA)	22.37^{a} (±0.26)	21.02^{b} (±0.24)
Poly-unsaturated Fatty Acids (PUFA)	3.50^{a} (±0.16)	3.53^{a} (±0.20)

Values are means ± SD.

Means in the same row for the same parameter bearing the same subscript letter are not significantly different (P>0.05).

4. CONCLUSION AND RECOMMENDATIONS:

4.1 Conclusion:

- Chemical composition was insignificantly (P>0.05) influence by the milk source.
- Total solid, protein and lactose content of cow's yoghurt was higher than camel's one.
- Milk source insignificant (P≥0.05) effect on fat content of yoghurt.
- Calcium content of yoghurt was significantly (P≤0.05) affected by milk source.
- Camel's yoghurt had higher phosphorus content 92.36mg/100g when compared to cow's one 87.33mg/100g.
- Camel's yoghurt had significantly (P<0.05) higher (79.10%) saturated fatty acids (SFA) when compared to cow's yoghurt (69.17%).
- Polyunsaturated fatty acid of yoghurt Insignificantly (P<0.0) affect by the milk source.
- Cow's yoghurt had (3.50%) PUFA, while, camel's yoghurt had (3.53%).
- Generally, camel yoghurt had contain more nutrients than cow's one.

4.2 Recommendations:

- Further research is needed to study the amino acids profile, another minerals and sensory characteristics of yoghurt processed from cow different milk source.

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