
UNIVERSITI PUTRA MALAYSIA

# NUTRIENT COMPOSITION OF MILK FROM DIFFERENT BUFFALO BREEDS IN BUFFALO BREEDING AND RESEARCH CENTER, TELUPID, SABAH

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**FACULTY OF VETERINARY MEDICINE**

**UNIVERSITI PUTRA MALAYSIA**

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## CERTIFICATION

It is hereby certified that we have read this project paper entitled "Nutrient Composition of Milk from Different Buffalo Breeds in Buffalo Breeding and Research Center Telupid, Sabah", by Mohamad Fauzi bin Taslim Galli and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

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# DEDICATIONS

*In the name of Allah, The Most Benevolent, The Most Merciful*

Mostly dedicated to:

*Ayah, Mama, Kak Ika, Aiman, and Adiba.*

*Love you guys so much.*

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## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| **BM** | = | Buffalo milk |
| **SNF** | = | Solid non-fat |
| **%** | = | Percentage |
| **kg** | = | Kilogram |
| **ml** | = | millilitre |
| ***et al.*** | = | et al. (abbr. Latin) et alii (and others) |
| **kcal** | = | kilocalorie |
| **v/v** | = | volume/volume |
| **m** | = | meter |
| **mm** | = | millimetre |
| **µl** | = | microliter |
| **°C** | = | degree Celsius |
| **µm** | = | micrometre |

## LIST OF TABLES

# ABSTRAK

Abstrak daripada projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Ilmiah Tahun Akhir

**KOMPOSISI NUTRIEN SUSU DARIPADA PELBAGAI BAKA KERBAU DI PUSAT PENYELIDIKAN DAN TERNAKAN KERBAU, TELUPID, SABAH**

**Oleh**

**Mohamad Fauzi bin Taslim Galli**

**2017**

**Supervisor: Dr. Intan Shameha binti Abdul Razak**

**Co-Supervisor: Dr. Hasliza binti Abu Hassim**

Peningkatan pengambilan produk tenusu di kalangan rakyat Malaysia menunjukkan pertumbuhan yang stabil sejak kebelakangan ini. Oleh yang demikian, susu kerbau berpotensi sebagai sumber tenusu alternatif bagi memenuhi permintaan. Walau bagaimanapun, potensi nutrien susu kerbau belum dikaji sepenuhnya dan maklumat tentang susu kerbau dari baka asli dan kacukan berbeza masih agak terhad. Oleh itu, kajian dan perbandingan komposisi nutrien dan asid lemak susu kerbau dibuat pada sampel susu kerbau Murrah kacuk dan sawah di Pusat Pembiakan dan

Penyelidikan Kerbau, Telupid, Sabah. Sebanyak 6 ekor kerbau dari setiap baka telah digunakan (n=12). Sampel susu dikumpulkan daripada setiap baka dan diawet dengan formalin 40%, disejukkan pada suhu 40°C sebelum analisis lanjut dilakukan. Komposisi susu seperti susu lemak, protein, kasein, laktosa, jumlah pepejal, dan profil asid lemak telah ditentukan. Keputusan menunjukkan bahawa susu kerbau Murrah kacuk mengandungi 2.21% lemak, 5.62% protein, 4.83% laktosa, 4.96% kasein, dan 14.11% jumlah pepejal. Sementara itu, susu dari kerbau sawah terkandung 6.25% protein, 1.55% lemak, 5.55% kasein, 4.65% laktosa dan 14.04% jumlah pepejal. Keputusan kajian menunjukkan tiada perbezaan yang signifikan antara kedua-dua kerbau Murrah kacuk dan sawah dalam semua parameter komposisi susu. Bagi komposisi asid lemak, sampel susu dari kerbau Murrah kacuk didapati mengandungi asid tinggi monotaktepu lemak (MUFA) dan asid tepu lemak (SFA) dan asid rendah politaktepu lemak (PUFA) berbanding kerbau sawah. Sebagai perbandingan, komposisi nutrien terutama kandungan protein dan lemak adalah susu kerbau adalah setanding dengan susu lembu. Kesimpulannya, susu kerbau mempunyai potensi yang besar sebagai sumber tenusu untuk kegunaan manusia.

**Kata kunci**: susu, komposisi susu, asid lemak, Murrah, sawah, kerbau

# ABSTRACT

An abstract from the project paper presented to the Faculty of Veterinary Medicine in the partial fulfilment of course VPD 4999 – Project

**NUTRIENT COMPOSITION OF MILK FROM DIFFERENT BUFFALO BREEDS IN PUSAT TERNAKAN KERBAU TELUPID, SABAH**

**By**

**Mohamad Fauzi bin Taslim Galli**

**2017**

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**Co-Supervisor: Dr. Hasliza binti Abu Hassim**

The increasing consumption of dairy products among Malaysian showed steady growth for past few years. This bring potential of buffalo milk to be alternative dairy resource to fulfil the demand. However, the nutrient potential of buffalo milk (BM) has not been fully determined and the information about BM from different breeds and crossbreeds is still quite limited. Therefore, the nutrient compositions and fatty acids of BM were determined in milk samples from Murrah crossbred and Swamp buffaloes at Buffalo Breeding and Research Center, Telupid, Sabah. A total of 6 buffaloes from each breed were used (n=12). Milk samples were collected from

each breed and preserved with 40% formalin, chilled at 4OC prior to further analysis. The milk compositions such as milk fat, protein, casein, lactose, total solid, and fatty acid profiles were determined. Results revealed that milk of Murrah cross buffaloes contained 2.21% fat, 5.62% protein, 4.83% lactose, 4.96% casein, and 14.11% total solid. Meanwhile, milk from swamp buffaloes contained 6.25% protein, 1.55% fat, 5.55% casein, 4.65% lactose and 14.04% total solid. From the results, there were no significant difference between both Murrah crossbred and Swamp buffaloes in all milk composition parameters. As for the fatty acids composition, milk samples from Murrah crossbred was found to contain high monounsaturated fatty acids (MUFAs) and saturated fatty acids (SFAs) and low polyunsaturated fatty acids (PUFAs) as compared to Swamp buffaloes. In comparison of these nutrients composition particularly on the protein and fat content of BM with cow milk, it can be concluded that the BM has a great potential to be considered as a dairy source for human consumption.

**Keywords**: milk, milk composition, fatty acids, Murrah, Swamp, buffalo

# 1.0 INTRODUCTION

## 1.1 Background of the study

Milk is a major source of dietary energy, protein and fat, contributing on average 134 kcal of energy/person/day, 8 g of protein/person per day and 7.3 g of fat/person per day in 2009 (FAO, 2013). In Malaysia, as of year, 2000, milk consumed is 1.57 kg per person, 0.44 kg per person of butter, 0.22 kg per person cheese, 3.33 kg per person of non-fat dairy and 2.14 kg per person of whole meat powder (USDA, 2000). Buffaloes are the second largest milk producers in the world (IDF, 2009). The buffalo milk, multiple fat-rich dairy products are produced such as cream, butter, ghee and numerous types of cheeses (Pandaya & Khan, 2006). A study done by Sun and coworkers showed that there was statistically significant difference in the proportions of gross chemical composition, fatty acids and amino acids between river buffalo breeds and Nilli Ravi and river cross breeds (Sun et al., 2014). The indigenous breed of buffalo in Malaysia is the swamp buffalo and is traditionally used for ploughing. Murrah buffaloes were imported from the Indian subcontinent in the 1920s and are mostly found in Selangor, Perak and Kedah and raised for milk production. These buffaloes were brought by Chinese traders to Sabah during the pre-World War II period (DVS, 2013). In Malaysia, buffalo milk production is still low due to the declining population of buffaloes. Hence, the research in this area particularly the nutrient composition of milk has not been determined from these breeds reared in Telupid.

## 1.2 Overall Objectives of the study

1. To determine the nutrient compositions of milk of swamp and Murrah cross buffaloes.
2. To compare the nutrient compositions of milk between swamp and Murrah cross buffaloes.

## 1.3 Justification of the study

1. The increasing consumption of dairy products among Malaysian showed a steady growth for past few years.

   The nutrient potential of buffalo milk (BM) has not been fully determined and the information about BM from different breeds and crossbreeds is still quite limited.

## 1.4 Hypotheses of the study

**Ho:** There is no significant difference in the nutrient compositions of milk between swamp and Murrah cross buffaloes.

**Ha:** There is significant difference in the nutrient compositions of milk between swamp and Murrah cross buffaloes.

# 2.0 LITERATURE REVIEW

## 2.1 Trend of milk consumption in Malaysia

Milk which is also known as the secretion produced by animal's mammary gland especially cows, buffaloes, goats and sheep used for human consumption in a variety range of dairy products worldwide (Walstra *et al.*, 2006). Malaysia relies heavily on importation to satisfy domestic demand for dairy products. The dairy product import value had increased from RM69 million in 1970 to RM1.2 billion in 2014. Although the milk production has increased over the past decades, Malaysia is still unable to meet the demand (Rachel & Chubashini, 2015). Between 1990 & 2005, consumption of fresh whole milk increased by 33% from 32.9kg/person/day to 43.5kg/person/day (Boniface & Umberger, 2012). The increasing awareness on nutritional benefits coupled with increasing preference on dairy products has contributed to increase demand of dairy product in Malaysia.

Therefore, the rising demand has driven the government to formulate policies and suggest steps to meet the need (Rachel & Chubashini, 2015). Global demand for daily products experienced a dramatic increase as the consumers in developing countries become more affluent. (Ishida et al., 2003; Warr et al., 2008). Growing evidence and awareness that dairy products able to meet essential vitamins and nutrients requirements causing the demand growth. (Heaney, 2000; McGill et al., 2008; Wang, Manson, Buring, Lee & Sesso, 2008). An example of this change can be seen in Malaysia, where traditionally, the morning meal (breakfast) consisted of rice or noodles, but has now significantly shifted to milk, bread and butter. Malaysians also now spend more on milk and dairy products than rice (Ishida et al., 2003).

## 2.2 Buffalo milk industry

Buffaloes milk production came second after cow accounted 13% of the total milk production (87.5 million tonnes per year) in the world, with rapid annual growth rate (IDF,2009). There is steady increase of volume of buffalo milk in the trends of world milk production over the five years to 2004 indicating steady increase about three percent per year (see Table 1).

**Table 1:** Trends in world buffalo milk production – a comparison with cow's milk production.

| *Parameters (%)* | *Years* | | | | |
|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | 2004 |
| *Increase in world cow milk* | 2 | 1 | 2 | 2 | 0 |
| *Cow milk of total world milk* | 85 | 85 | 85 | 84 | 84 |
| *Total world cow milk (Mt)* | 488,057,837 | 494,618,011 | 505,222,503 | 514,035,351 | 513,312,002 |
| *Increase in world buffalo milk* | 3 | 4 | 3 | 4 | 1 |
| *Buffalo milk of total world milk* | 12 | 12 | 12 | 12 | 12 |
| *Total world buffalo milk (Mt)* | 67,417,389 | 70,414,905 | 72,288,775 | 75,372,769 | 75,833,191 |

(FAO, 2004)

High nutrients contents have made buffalo's milk more preferred for processing of milk products, such as ice cream, yoghurt, butter fat and cheese, than cow's milk (Fundora et al., 2004; Wedholm et al., 2006). Buffalo milk is used for a

variety of different milk products such as butter, butter oil (clarified butter or ghee), soft and hard cheeses, condensed or evaporated milks, ice cream, yoghurt and buttermilk. The properties of buffalo milk make it very suitable for processing. For example, it takes eight kilograms of cow's milk to produce one kilogram of cheese, while it takes only five kilograms of buffalo milk (BSTID, 1981). In India, 28% of the total milk production is converted into ghee and about 20% is converted into products such as dahi (curd), khoa (dehy- drated milk) and a variety of milk sweets (Chantalakhana and Falvey, 1999).

**2.3 Breed of buffaloes and their origin**

The domestic water buffalo *Bubalus bubalis*, belongs to the family Bovidae, sub-family *Bovinae*, genus *bubalis* and species *arni* or wild Indian buffalo (Chantalakhana and Falvey, 1999). Buffalo are categorised into two distinct classes: swamp buffalo and river buffalo.

Swamp buffalo are found in China, Thailand, the Philippines, Indonesia, Vietnam, Myanmar, Laos, Sri Lanka, as well as Malaysia. They are mainly used as draught animals, especially in rice cultivation. Due to low quantities of milk produced of 1.0 to 1.5 litres per day, they are not heavily utilised in milk production (Chantalakhana and Falvey, 1999). However, the swamp buffalo might be used for meat production purpose (BSTID, 1981). Their preference for wallowing in stagnant water pools and mud holes bring the 'swamp' name for them (Subasinghe et al., 1998).

The riverine breeds of the Indian sub-continent are mainly kept for milk production have a daily milk yield between 7 – 10 litres (Thomas, 2004). Their behaviour of always wallowing in running water, thus bring the name 'river buffalo'

(Subasinghe et al., 1998). The Murrah buffaloes in India have an average lactation length of 319 to 331 days with a total milk yield of 1866 to 2304 kg per lactation (Falvey and Chantalakhana, 1999). Cross breeding local buffalo with high yielding elite buffalo has now started in several countries. (Lind, Svennersten-Sjauna, & Bruckmaier, 2015).

The indigenous breed of buffalo in Malaysia is the swamp buffalo and is traditionally used for ploughing. Murrah buffaloes were imported from the Indian subcontinent in the 1920s and are mostly found in Selangor, Perak and Kedah and raised for milk production. These buffaloes were brought by Chinese traders to Sabah during the pre-World War II period (DVS, 2013).

**2.4 Buffalo Milk Compositions**

Buffalo milk is also one of the richest milks from a compositional point of view, particularly; fat which constitutes the main buffalo milk solids and is responsible for its high energy and nutritive value (Hamad et. al., 2007). Fat in buffalo milk has characteristic differences from fat in cow's milk. The fat globules in buffalo milk have an average diameter of 2.80 µm (Martini et al., 2003), smaller than those in cow milk, which have an average diameter of 3.0-5.0 µm (Alais, 1984). In buffalo milk 91% of fat globules range from 2.1 to 4.0 µm and the size is positively correlated to the proportion of unsaturated fatty acids (Martini et al., 2003). Buffalo milk was found superior in chemical composition than that of cow milk resulting more calories per unit weight (Sahai, 1996).

**Table 2:** Average Composition (%) of Milk from Indian Murrah Buffalo and Zebu Cow.

| Milk Constituent | Indian Murrah Buffalo | Zebu Cow |
|---|---|---|
| Fat | 7.9 | 4.2 |
| Protein | 4.2 | 3.6 |
| Lactose | 3.6 | 4.9 |
| S.N.F. | 10.2 | 9.2 |
| Total solids | 16.7 | 13.3 |

*(Ståhl Högberg and Lind, 2003)*

# 3.0 MATERIALS AND METHODS

## 3.1 Selection of farm and animals

This study was conducted in Buffalo Breeding and Research Centre, Telupid. A total of 12 lactating buffaloes from swamp and Murrah cross breed were selected. From the record, these buffaloes are ranging from 2-5 years old, and at 7-90 days of lactation.

## 3.2 Milk Samples Collection

The buffaloes were restrained in the crush with both hind leg tied to the crush pole. As soon as the animal appear calm, the milking procedures being done. The buffaloes' udder and teat were cleaned using water to remove dirt.

Next, the milk was stripped the first few streams of milk were discarded. Approximately about 60ml of milk samples were collected aseptically from all quarter. The sample then preserved using 40% formalin at a ratio of 1ml for every 160-180ml of milk (FSSAI,2001). The samples then stored at 4°C for further analyses.

### 3.4 Laboratory Analysis

#### 3.4.1 Milk Compositions Analysis

The milk composition parameters (milk fat, protein, casein, lactose, total solid, and solid non-fat) were analysed using Foss Milkoscan FT2 in Milk Quality Control Laboratories, Department of Veterinary Services, Malacca.

#### 3.4.2 Fatty Acid Profile Determination

The total fatty acids were extracted from the milk using chloroform:methanol 2:1 (v/v) based on the method of Folch *et al*. (1957) modified by Rajion (1985). About 3.0 ml of milk samples from each sample (6 samples) were poured into the glass tube using micropipette. After that, 5.0 ml of chloroform: methanol 2:1 v/v added into each tube. Five ml of normal saline solution were added to facilitate phase separation. The mixture was then shaken vigorously for one minute and was left to stand for four hours. After this washing phase, the lower phase contained 86 parts chloroform: 14 parts methanol: 1 part water (Shahidi and Wanasundara, 1998). The upper phase would contain 3: 48: 47 parts of chloroform, methanol and water respectively. The non-lipid contaminants would be retained in the aqueous upper phase (Christie, 1982). After complete separation at the end of fourth hour, the upper phase was discarded and lower phase was collected and evaporated by rotary evaporation (Heidolph GmBH, Germany) at 70 $^{0}$C. The total lipid extract was then immediately transferred to a capped methylation tube by re-diluting it with 5.0 ml fresh chloroform-methanol (2:1, v/v).

Transmethylation of the extracted fatty acids to their fatty acid methyl esters (FAME) were carried out using 14 % methanolic boron trifluoride ($BF_3$) according to methods in AOAC (2007). The methyl esters were quantified by GC (Agilent 7890N) using a 30m x 0.25mm ID (0.20 µm film thickness) Supelco SP-2330 capillary column (Supelco, Inc., Bellefonte, PA, USA).

One micro of FAME was injected by an auto sampler into the chromatograph, equipped with a split injector and a flame ionisation detector. The split ratio was 1:30 after injection of 1 µl of the FAME. The injector temperature was programmed at 250°C and the detector temperature was 300 °C. The column temperature program initiated runs at 100°C, for 2 min, warmed to 170 °C at 10 °C /min, held for 2 min, warmed to 220°C at 7.5 °C /min, and then held for 20 min to facilitate optimal separation. Fatty acid peaks were identified based on their retention times, compared to an external standard (Supelco external standard mix; Supelco Inc., Park Bellefonte, USA) and quantified using the internal standard (C21:0).

**3.5 Data Analysis**

Data analysis was done using IBM SPSS version 22.0 (SPSS software for Windows, IBM Corp.). The mean of milk compositions parameter between Murrah cross and sawah buffaloes was compared using Independent Sample T-test. The correlation between breed and milk compositions parameter was determined using Pearson correlation and $P < 0.05$ was considered significant.

# 4.0 RESULTS

## 4.1 Nutrient Compositions of Milk from Murrah Cross and Swamp Buffaloes

The mean values for nutrient compositions are recorded (Table 3. Based on the result, the means of fat, protein, total solid, casein and lactose were not significantly different ($p>0.05$) between the milk from Murrah cross and swamp buffaloes. Of all the parameters recorded, milk from Murrah cross buffaloes has higher protein, casein, lactose and total solid as compared to swamp buffaloes. Meanwhile, fat level is higher in milk from swamp buffaloes as compared to Murrah cross buffaloes.

**Table 3**: Nutrient composition of milk from Murrah cross and swamp buffalo (Mean ± SE).

| Nutrient composition (%) | Murrah cross, Mean ± SE | Swamp, Mean ± SE | P value* |
|---|---|---|---|
| **Fat** | 2.212 ± 0.552[a] | 1.553 ± 0.431 [a] | 0.341 |
| **Protein** | 5.620 ± 0.281 [a] | 6.251 ± 0.263 [a] | 0.173 |
| **Casein** | 4.695 ± 0.256 [a] | 5.552 ± 0.234 [a] | 0.148 |
| **Lactose** | 4.483 ± 0.167 [a] | 4.650 ± 0.187 [a] | 0.161 |
| **Total solid** | 14.112 ± 0.435 [a] | 14.045 ± 0.123 [a] | 0.512 |

[a] Values on the same row with same superscript indicate non-significant difference ($P>0.05$).

## 4.2 Milk Fatty Acid Compositions from Murrah Cross and Swamp Buffalo

The mean values for milk fatty acid compositions are recorded (Table 4). Based on the result, the means of Palmitic Acid (C16:0), Stearic Acid (18:0), Oleic Acid (C18:1), Linoleic Acid (C18:2), Linolenic Acid (C18:3) were not significantly different ($p>0.05$) between the milk from Murrah cross and swamp buffaloes. Stearic Acid (18:0) and Oleic Acid (C18:1) content are higher in milk from Murrah cross as compared to that of swamp buffalo. As for Palmitic Acid (C16:0), Linoleic Acid (C18:2) and Linolenic Acid (C18:3), milk from swamp buffaloes showed higher content as compared to Murrah cross buffaloes.

**Table 4**: Milk fatty acid composition from Murrah cross and swamp buffalo (Mean ± SE).

| Fatty Acid (%) | Murrah cross, Mean ± SE | Swamp, Mean ± SE | P value* |
|---|---|---|---|
| **Palmitic Acid (C16:0)** | 27.071 ± 1.069 [a] | 28.517 ± 2.917 [a] | 0.509 |
| **Stearic Acid (18:0)** | 20.043 ± 2.579 [a] | 16.317 ± 3.740 [a] | 0.330 |
| **Oleic Acid (C18:1)** | 22.657 ± 0.471 [a] | 21.887 ± 0.872 [a] | 0.476 |
| **Linoleic Acid (C18:2)** | 1.472 ± 0.105 [a] | 2.476 ± 0.927 [a] | 0.344 |
| **Linolenic Acid (C18:3)** | 0.833 ± 0.018 [a] | 1.787 ± 0.853 [a] | 0.326 |

[a] Values on the same row with same superscript indicate non-significant difference ($P>0.05$).

# 5.0 DISCUSSION

## 5.1 Nutrient Compositions of Milk from Murrah Cross and Swamp Buffalo

### 5.1.1 Fat.

Findings from present study showed that milk from Murrah cross contained higher fat content as compared to swamp buffaloes. This finding indeed consistent with the findings observed by Sun and co-workers (2014). However, the fat content is lower in milk from both breed of buffaloes as compared to those studies reported by Febrisiantosa *et. al*., in 2015 which was 9.94%. Lower fat content of milk in this study correlate with the findings by Looper et. al, 2014 which found out that fat content of milk was affected by the genetics, environment, production levels and period of lactation

### 5.1.2 Protein.

Milk from Murrah cross buffalo have lower protein content as compared to swamp buffaloes which is in contrast with the findings observed by Sun and co-workers (2014). The average protein content of Murrah cross and swamp buffaloes was 5.62 and 6.25% respectively, higher than the result reported by (Salman et al., 2014). Auldist et. al., in 2012 reported that age and period of lactation are among the factors affect the levels of protein in the milk.

### 5.1.3 Casein.

Protein in buffalo milk is 80% casein and 20% whey (Khan, 2006). Casein in milk play a role as coagulation properties and very important in cheese production (Khedkar, Kalyankar, & Deosarkar, 2016). Milk from swamp buffaloes depicted higher casein content compared to Murrah cross buffaloes' milk.

### 5.1.4 Lactose.

Lactose which is a disaccharide composed of galactose and glucose (Studdert et. al, 2012). Milk from Murrah cross buffaloes have higher lactose content as compared to swamp buffaloes consistent with the findings observed by Sun and co-workers (2014). From the present study, the lactose content reported was 4.65-4.83% also within the ranges determined from global milk production analysis by Barlowska et al. (2011).

### 5.1.5 Total solid.

Total solid content of milk from Murrah cross is higher than that of swamp buffaloes. This is in agreement with findings reported by Han et. al., (2007). The results are also in line with the observation of Enb et al. (2009) and their results showed that the total solid content of buffalo milk was higher than that of cow milk.

### 5.2 Milk Fatty Acid Composition of Murrah Cross and Swamp Buffalo

In this study, Murrah cross buffaloes produced lower palmitic (C16:0) but higher stearic acid (C18:0) content as compared to swamp buffaloes milk fat. This is in agreement with study done by Sun and co-workers (2013). Oleic acid (C18:1) content is higher in milk of Murrah cross buffaloes as compared to swamp buffaloes. Further studies may offer explanations of breed differences for fatty acid production. Medrano et al. 1999, observed that there are differences between breeds in the activity of mammary enzyme Stearoyl coenzyme A desaturase. The coenzyme responsible in oxidizing palmitic (C16:0) and stearic (C18:0) acids to Palmitoleic (C16:1) and (C18:1) oleic acids is involved in CLA production. The proportion of linoleic acid (C18:2) and linolenic acid (C18:3) were not significantly different ($P > 0.05$) between Murrah cross and swamp buffalo's milk fat. Other reported breed comparisons have also not detected differences in milk (C18:2) and (C18:3) between Holstein, Jersey and Czech Paed cows (Morales, 2000).

## 6.0 CONCLUSION AND RECOMMENDATIONS

From this study, results revealed that milk of Murrah cross buffaloes contained 2.21% fat, 5.62% protein, 4.83% lactose, 4.96% casein, and 14.11% total solid. Meanwhile, milk from swamp buffaloes contained 6.25% protein, 1.55% fat, 5.55% casein, 4.65% lactose and 14.04% total solid. This study revealed that there are no significant differences in term of nutritional and milk fatty acid compositions of milk from both breed of buffaloes. Milk from both breed are equivalent in nutrient point of view. High protein and low fat content showed that both milks are of good qualities. Fatty acids profile comprised of total saturated fatty acids (SFAs), mono-unsaturated fatty acids (MUFAs), and poly-unsaturated fatty acids (PUFAs) of milk samples from buffalo breeds and crossbreeds were determined, respectively. However, there is no significant statistical difference for SFAs, MUFAs, and PUFAs from both breeds of buffaloes. Milk from Murrah cross buffaloes was found to contain more monounsaturated fatty acids (MUFAs) and saturated fatty acids (SFAs) and less polyunsaturated fatty acids (PUFAs) than milk from swamp buffaloes.

As a recommendation for future study, it is encouraged to include a larger sample size from both breed of buffaloes for a better statistically significant results considering a few confounding factors such as age, and lactational stage.

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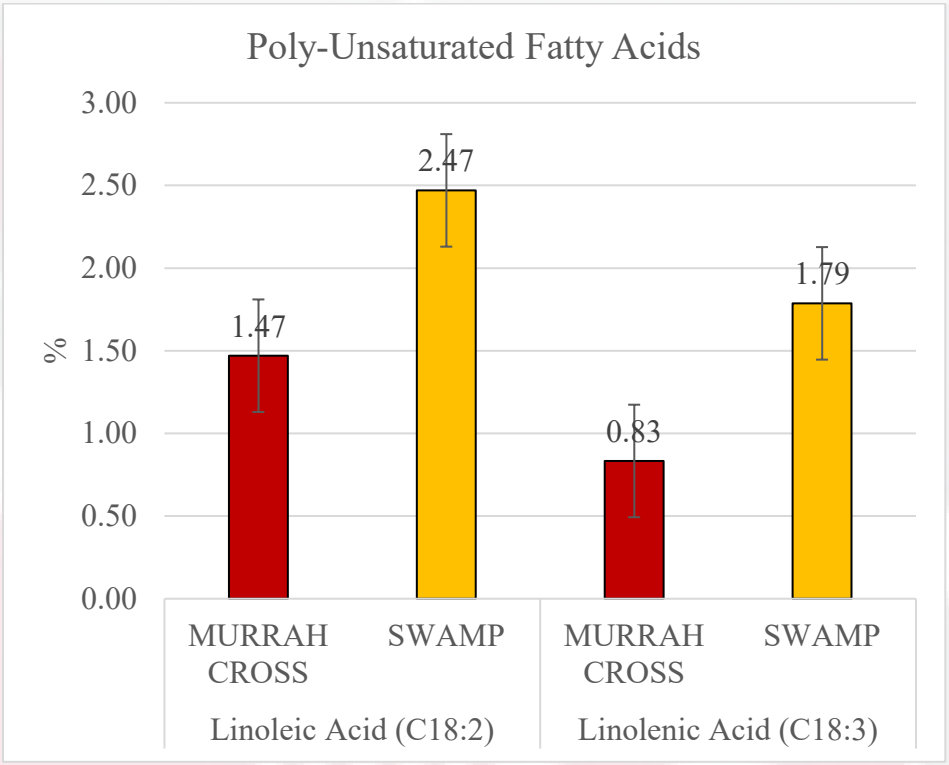
# APPENDICES

APPENDIX A

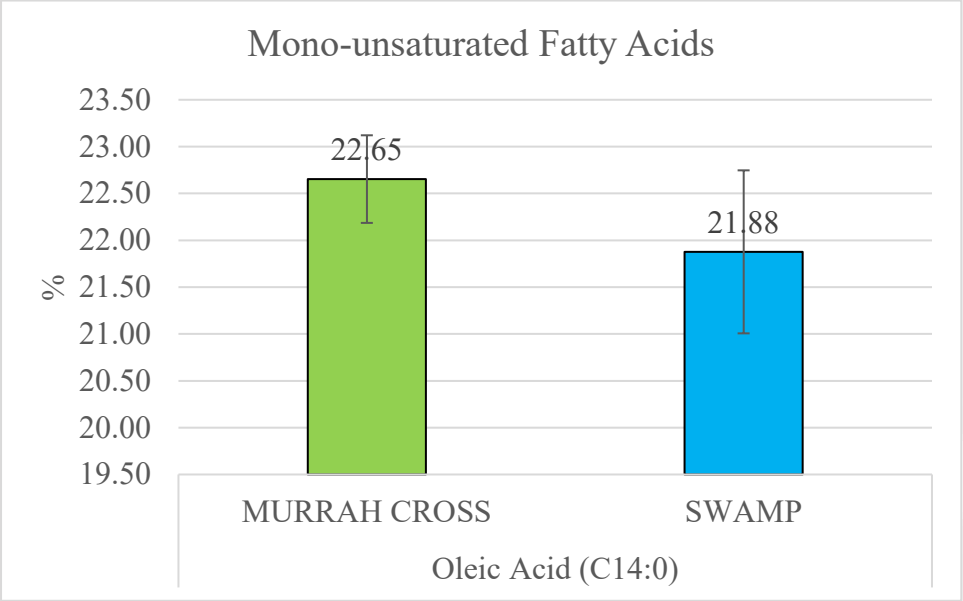
Hand milking done on the buffalo.

APPENDIX B



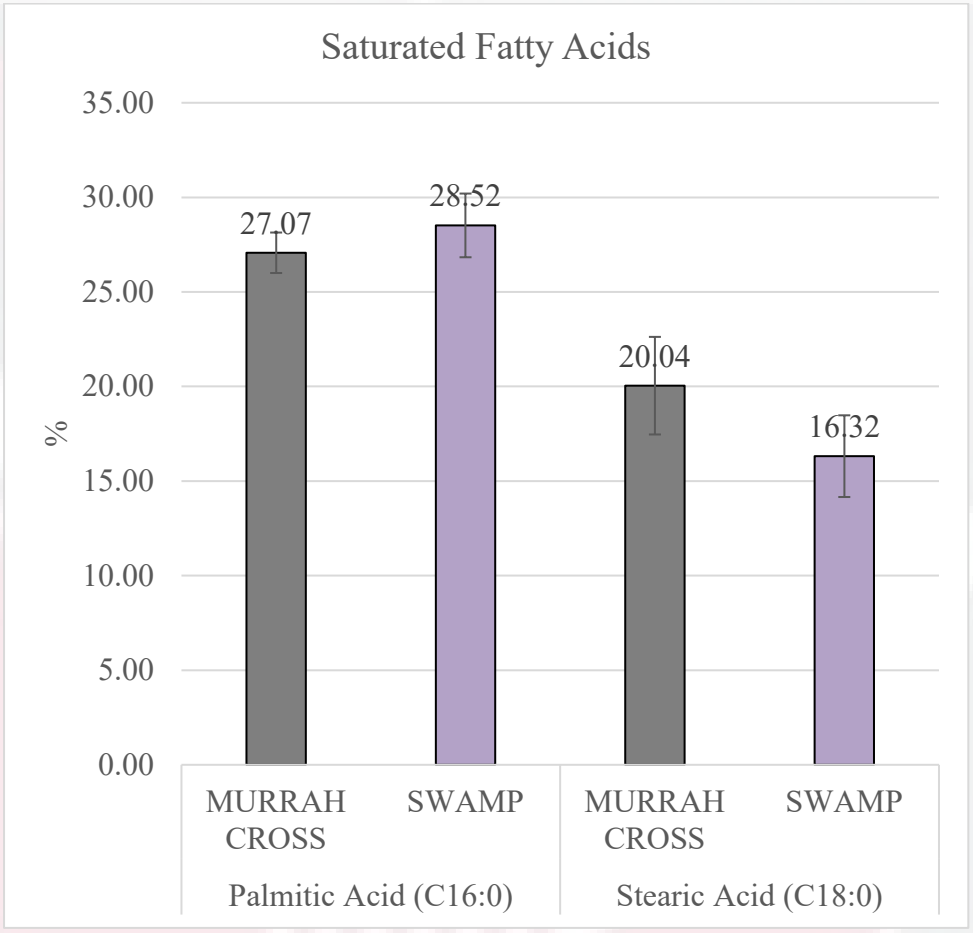

Milk poly-unsaturated fatty acid contents from both breeds of buffaloes.

APPENDIX C




Milk mono-unsaturated fatty acid contents from both breeds of buffaloes.

APPENDIX D




Milk saturated fatty acid contents from both breeds of buffaloes.

APPENDIX E


FOSS Milkoscan™ FT2 – Milk composition Analysis