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# Recovery of butter from camel milk by blending with cow milk at different proportion.

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## Abstract

The study was conducted on butter making from camel milk by blending with cow milk at different proportion. The experiment was laid out in completely randomized design with five treatments which is compressed of T1(100% camel), T2(65% camel and 35% cow milk), T3(35% camel and 65% cow milk), T4(50% camel and 50%cow milk) and T5 (100% cow milk).The sampled milk were analyzed for physicochemical properties. Fat, total solids and titratable acidity of T1 was significantly ($p<0.05$) lower than T5, but T1 had significantly higher than PH and RI than T3, T4 and T5. The churning efficiency and physic-chemical properties of the butter sample were analyzed by using the standard procedures. The fermentation time (10.5 days, churning time(121.17min) and churning temperature(27°c) of T1 was significantly ($p<0.05$)higher than the other milk samples. T1 had significantly ($p<0.05$) lower in butter yield(46.08g/L) than the other samples. The highest values were obtained in T4 whereas it is followed with T3. However, there were no significant difference ($p<0.05$) between T3 and T4. The fermentation time, churning time and churning temperature of T5 was significantly shorter than the others. The melting point and PH of T1 was higher, whereas, the fat content was significantly lower than others. This finding was indicated that blending of camel milk with cow milk could be improved almost all parameters of the study. However, additional investigation will be required churning time, fermentation time and enter whole butter yield.

**Keywords:** Butter processing, Churning time, fermentation time, Blending

## 1. Introduction

According to the FAO live animals Statistics the worldwide camel population is 35 million heads (FAO, 2019), most of which are in Somalia, Sudan, Niger, Kenya, Chad, Ethiopia, Mali, Mauritania, and Pakistan. Camels live in the vast pastoral areas in Africa and Asia and are divided into two different species belonging to the *genus Camelus*. Dromedary camels (*Camelus dromedarius*, one-humped) mainly live in the desert areas (arid), and the Bactrian camel (*Camelus bactrianus*, two-humped) prefer to live in the cooler areas. More than 60% of the dromedary camel population is concentrated in the four East African countries viz. Somalia, Sudan, Ethiopia, and Kenya [1]. FAO (2010), the report revealed that Ethiopia possesses over 2.4 million dromedary camels that standing the

country third in Africa in camel population next to Somalia and Sudan.

Camel milk is not churnable by the traditional methods owing to the chemical nature of the milk. Therefore, milk produced from camels is primarily used for direct consumption by the pastoralists. Pastoralists claim that it is difficult to churn camel milk to make butter [2] stated that butter from camel milk cannot be obtained so easily using the traditional churning methods because camel milk shows little tendency to cream up and the fat in camel milk is firmly bound to the protein [3]. Although it is difficult to make butter from camel milk, reports revealed that butter can be made from camel milk by churning fresh or soured camel milk at 24-25$^0$C [4].

In pastoral areas, large amounts of camel milk are produced but butter making from camel milk is difficult due to the inherent characteristics of the milk. In addition to camel milk, milk from small ruminants particularly goats is also available in pastoral areas. Thus, the possibility exists to make butter from camel milk by blending it with goat milk. In this study it is hypothesized that blending camel milk with goat milk will improve butter making efficiency from camel milk. Hence, knowledge of the factors that influence butter making and the possibilities of churning camel milk to make butter are very important aspects of camel milk processing for enhancing the product and value addition of camel milk that will subsequently enrich the diets and income of the pastoralists. Fresh milk is easily perishable if it is not consumed immediately. So when surplus amount of milk is produced, it should be processed into different products like butter, soured milk and cheese. Butter has long shelf life as compared to fresh milk, especially when heated to higher temperature (100-120$^0$C) for 30 minutes it can stay for several months without spoilage [5].

Camel milk butter is believed to have some medicinal properties and laxative properties for gastrointestinal discomfort in different parts of the world [3]. In the Sahara, fresh butter made from camel milk is not usually consumed rather used for medicinal purpose. Camel milk butter is also used in the preparation of nutritious and medical soups. The byproduct of butter, i.e., buttermilk, is used as a functional ingredient in many food products such as salad dressings, pasta sauces, chocolate, cheese seasonings, ice cream mixes, and yoghurt (Fox, *et al.*, 2000). Therefore, this study was designed to find out the efficiency of butter making from camel by blending with cow milk.

## 2. Materials and Methods

### *2.1. Description of the study area*

The study will be conducted in Yabello wared of Borana Zone. It is located in the southern part of Ethiopia in Oromia National Regional State, at a distance of 565 km from Addis Ababa. Its astronomical location is 4º53’’North latitude and 38º06’ East longitude. Yabelo is one of the reform towns in the region and has a city administration; municipality. The town has Integrated Development Plan which was prepared in 2007.

### *2.2. Milk Sample Collection*

Before collection of milk samples two kebeles were selected by using purposive sampling techniques based on their camel and cow milk production potential and availability of lactating animals. Based on these previous assessment, lactating camels and cows were stratified into early (1-2 months), mid (3-4 months) and late 5 and above months of lactation stage, in order to see the physio-chemical properties of the products. Milk samples were collected from camels and cows from 20 and 25 households, respectively. After collection, the milk samples were taken to the Dairy Laboratory of Hawasa University by placing it under ice box. For fermenting, the milk 10 airtight plastic Jericans containers (10 liter capacity) were used. These containers were filled with either pure camel milk or camel milk blended with cow milk at different proportions and the milk samples were kept in the laboratory at room temperature until the required level of acidity, i.e., pH of 4.13, was attained. A

total of 50 liters of camel milk and 50 liters of cow milk were collected from the areas mentioned above for butter making in three replication of the same amounts of milks. The amounts of milk were including the samples used for the chemical analysis.

## Treatments

The experiment had five treatments, i.e., T1, T2, T3, T4 and T5 with the proportion of, T1 (100% camel), T2 a mixture of (75% camel +25% cow), T3 (25% camel +75% cow), T4 (50% camel +50% cow), and T5, (100% cow) were used for experimental study. The experiments were repeated three times for each parameter. Each unit was containing four liters of milk.

### *2.3. Butter making*

Before commencing the actual experiments, Preliminary experiments have been done in order to standardize the butter making procedures (temperature, pH and method of agitation). After standardizing the butter making procedure the actual experiment was conducted at pH values of 4.10 and at a churning temperature of 22°c-23°c by agitating the churn vertically (up and down movement). All the soured milk samples were churned at the same Ph, temperature and the same method of agitation. The temperature of the soured milk just before churning was adjusted by putting the container that contains the soured milk in a vat contains hot water. Thermometer was inserted into the soured milk and the milk was stirred before measuring the temperature. After intended temperature of milk was attained, the soured milk was removed from the hot water and churned immediately. The method agitation used was rapid swaying of the churn at a vertical position (up and down movement)by hanging the container on the pole. This churning method is easy because the person doing the churn ie required to apply only the upward force and the downward movement occurs by the help of gravitational forces. Hence, a higher churning force is employed by this method of churning as compared to the conventional (back and fro agitation method) which facilitate butter extraction from camel milk. The need for vigorous shaking of fermented milk for production of camel milk butter reported by [6]. As a result large force may required to separate the fat globule from the protein and to break the tick globules member of camel milk. It has also been reported that small fat globules have larger surface area in relation to their mass which tends to increase their resistances to creaming and cause major obstacle in butter making [7]. For butter making, fermented milk was filled to about one-fourth of the capacity of a plastic bottle jerykan. At the end of the churning process, the butter grains were skimmed off, kneaded in cold water and washed to remove visible residual of buttermilk. Butter yield were determined by measuring the weight of butter using a sensitive balance.

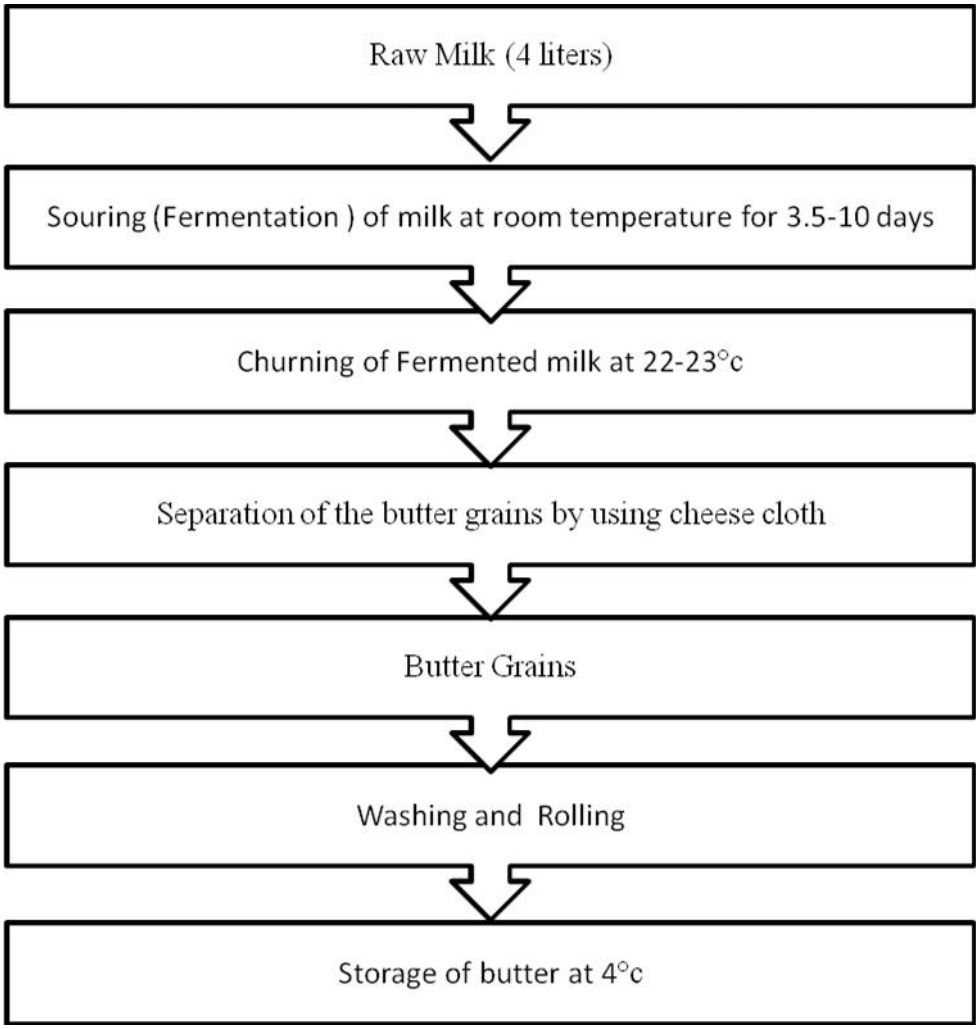


Figure1. Flow Diagram of the Traditional butter making Process used in the study

### *2.5. Experimental Design*

The design for the experiment was completely randomized design (CRD).

The model used was **:** $Y_{ij} = \mu + ti + \varepsilon_{ij}$

Where: $Y_{ij}$ = the $j^{th}$ observation of the $i^{th}$ treatment

$\mu$ = overall mean,

$t_i$ = the treatment effect (blend level) of the $i^{th}$ treatment

$\varepsilon_{ij}$ = the random error

### *2.6. Physicochemical Properties of Milk*

The physicochemical Properties of milk was evaluated for total solid, fat, pH by using the methods of Richardson, 1985, whereas, titratable acidity and Specific gravity of milk could be analyzed according to the methods of [8].

### 2.7. Physicochemical Properties of Butter

Fat content, melting range, Refractive Index and Acid degree values of butter made from sampled milk were evaluated by implementing Methods of [9], [10], and AOAC (1995) respectively.

### 2.8. Data Analysis

Analysis of variance (ANOVA) was used for analyzing the physicochemical data of milk and butter samples using the General Linear Model (GLM) of SAS (1999). When analysis of variance showed significant differences, least significant difference (LSD) was employed to detect differences among treatment means.

## 3. Results and Discussion

### 3.1. Respondent Personal Characteristics

The mean family sizes per household of the area was 6.50 person, which is higher than the found of 5.26 and 4.14 of [11]Ahmed and [12] in the same area of the study respectively. The proportion of children (<18 years of age) was (40.5%), middle age group (18-60 years age was 45.5% and those >60 years age was 14.0%. The educational status of the respondents in the area was illiterate, read and write with the proportion of 70.6% and 29.4% respectively.

### 3.2. Physicochemical Prosperities of Milk Used For Butter Making

The mean values for fat content of raw milk of camels, cow and their blends used for the butter making experiment are shown in Table 2. The fat content of 100% camel milk (T1) was significantly lower (P<0.05) than the fat content of the control (T5) and that of T3 and T4 (Table 2). However, no significant (P>0.05) difference in fat content was observed in milk samples T1 and T2. With increased proportions of cows' milk in the blend, the fat content of milk samples kept on increasing (Table 2). The fat content of camel milk (T1) observed in the present study is between with the findings of [13] who reported a fat content of 1.2-6.4% for fresh camel milk.). The fat content of cow milk in present study is in agreement with results of earlier studies. [14] reported a fat content of 3.16 - 4.73% for cow milk. The variation observed in fat contents of camel and cow milk of the present study vis-a-vis past published reports could be due to difference in stage of lactation, nutritional status and breed of animals. FAO (1982) reported that the hydration status of the animals as well as the type of forage eaten affect the fat content of camel milk.

Camel milk contains all the essential nutrients that present in cow's milk and its composition is similar to cow milk. However, [15], and [16] reported that the pH and specific gravity of camel milk were lower than cow milk which is comparable with the current finding. Contrast to these [17]reported that the higher PH(6.77) titratable acidity (0.18)% values for camel milk than the respective values observed in present study for camel milk. On the other hand, they reported that lower values of total solid, solid not fat and fat content is camel milk as compared to the values observed in the present study for camel milk. This variation might be due to breed and environmental factor. The protein and ash contents of cow milk is greater than camel milk in present finding with significant (p<0.05) difference.

Table 2. Physicochemical properties of raw milk of camels, cow and their blends used for butter making

| Variable | Treatments (Mean±SD) | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 |
| Fat (%) | $3.4800^{a}$±0.33 | $3.5800^{a}$±0.58 | $4.1075^{ab}$±0.69 | $4.0050^{ab}$±0.41 | $4.4450^{b}$±0.70 |
| TS (%) | $11.4250^{a}$±0.95 | $14.4850^{ab}$±0.99 | $11.4700^{a}$±0.05 | $13.6700^{b}$±0.48 | $12.8475^{b}$±0.20 |
| pH | $6.662^{b}$±0.02 | $6.55^{a}$±0.11 | $6.71^{b}$±0.06 | $6.68^{b}$±0.07 | $6.72^{bc}$±0.02 |
| TA (%LA) | $0.1425^{a}$±0.01 | $0.1482^{ab}$±0.02 | $0.1708^{b}$±0.10 | $0.1675^{ab}$±0.01 | $0.1705^{b}$±0.01 |
| Sg | $1.0270^{b}$±0.00 | $1.02984^{ab}$±0.00 | $1.0321^{ab}$±0.001 | $1.0343^{ab}$±0.001 | $1.0343^{b}$±0.007 |
| SNF | $8.8500^{a}$±0.24 | $8.8650^{a}$±0.50 | $8.8825^{a}$±0.09 | $8.88375^{a}$±0.48 | $8.9225^{a}$±0.19 |
| Protein | $3.1950^{a}$±0.2 | $3.2200^{a}$±0.21 | $3.3500^{a}$±0.18 | $3.2650^{a}$±0.36 | $3.3525^{a}$±0.03 |
| Ash | $0.715^{a}$±0.11 | $0.7250^{a}$±0.048 | $0.7325^{a}$±0.013 | $0.7300^{a}$±0.05 | $0.7600^{a}$±0.014 |

*TS = total solids; SNF= solid not fat, TA = titratable acidity; LA = lactic acid; Sg = specific gravity; T1 = 100% camel milk type; T2 = 75% camel + 25% cow milk type;T3 = 50% camel +50% cow milk type; T4 = 25% camel +75% cow milk type and T5 = control (100% cow milk); Means with different superscript letters in a row are significantly different (P<0.05); values in the table are means±SD of three replications.

### 3.3. Churning Efficiency of Butter Made From Camel Milk Blended With Cow Milk

Pure camel milk (T1) took significantly longer ($p<0.05$) time (10.5 days) to ferment as compared to the other samples (Table 3). In the country pure cow milk (T5) took significantly shorter ($p<0.05$) time (3.3 days) to ferment as compared to other samples. With increasing the proportion of cow milk in the blend the fermentation time kept on decreasing (Table 3). The longer fermentation time observed in treatment one in the present study is in line with the earlier report of [6] and [18]. Camel milk exhibits a two to three hold longer coagulation time compared with bovine milk [19]. This is attributed to the difference in the sizes of fat globules that is mainly related to the availability of fat globules membrane. Camel milk coagulum was reported to contain a greater number of large casein micelles than bovine milk coagulum [20]. Pure camel milk (T1) required significant higher ($p<0.05$) temperature for churning as compared to other sample (Table 3). Whereas the churning temperature of pure cow milk was significantly lower. With increased proportion of cow milk in blend, the churning temperature kept on decreasing, while inversed result was observed in pH values. The churning temperature applied on 100% of camel milk is greater than (27°c) finding of[4], but it is lower than [6](28°c).

Butter yield obtained from pure came milk was significantly ($p<0.05$) higher than other milk sample. However, the yield in T3, T4 and T5 was not shown any significant difference. With increased the proportion of camel milk in the mixture the yield of butter was kept on increasing. Compared to cow milk butter, camel milk butter is white in color, stickier and greasy in consistency. White color of camel milk butter could be attributed to the low carotene content in camel milk. The possibilities of butter making from camel milk was supported by the report of [21] and [6]. The churning time of camel milk was significantly ($p<0.05$) longer than cow milk. As the result indicated that the increased proportion of cow milk would resulting in decreased churning time of milk. The reason for the different churning behavior of camel milk fat in comparison to cow milk fat can partly be attributed to the melting point of camel milk fat. Small fat globules have a large surface in relation to their mass that tends to increase their the resistances for creaming up of butter from camel milk[18].

Table 1. Churning efficiency of butter made from camel milk blended with cow milk

| Parameters | Treatments (Butter) | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 |
| F time (days) | $10.5^{d}$±0.68 | $8.5^{c}$±0.04 | $4.5^{b}$±0.13 | $5.00^{b}$ ±0.30 | $3.30^{a}$ ±0.30 |
| Ch T ($^{0}$C) | $27.00^{a}$±0.87 | $20.00^{b}$±0.90 | $16.00^{c}$±0.85 | $12.00^{d}$±0.90 | $10.00^{e}$±1.00 |
| Ch time (min) | $121.17^{e}$±2.42 | $103.75^{d}$±1.53 | $79.500^{b}$±4.20 | $92.500^{c}$±2.08 | $55.00^{e}$±2.20 |
| Yield (g/liters) | $46.075^{c}$±2.66 | $58.66^{c}$±7.55 | $88.92^{a}$±1.029 | $103.66^{a}$±1.96 | $81.42^{c}$±0.25 |

*F = fermentation; Ch T = churning temperature; T1 = 100% camel milk type; T2 = 75% camel+25% cow milk type; T3 = 50% camel+50% cow milk type; T4 = 25%camel+75% cow milk type and T5 = control (100% cow milk); Means with different superscript letters in a row are significantly different ($P<0.05$); values in the table are means±SD of three replications.

### 3.4. Chemical Composition of Butter Made From Camel Milk Blended With Cow Milk

In this finding the significant ($p<0.05$) difference in fat, pH, Acid degree values and total solid content of butter was observed among treatments. The fat content of pure camel milk was significantly lower than other (Table 8). However, pH, melting point, RI, and ADV of camel milk was significantly ($p<0.05$) higher than other samples of treatment. The low content of camel milk butter observed in this finding may be attributed to high amount of non-fat components such as protein linked to the fat globules of camel milk butter as reported by [4].

Olfa (2009) revealed that the fat content of cow milk butter was 65.7% that is smaller than the result of this finding, whereas, [22] found the fat content of camel milk butter range from 55-59% which is comparable to the finding of this study. The RI value of cow milk butter is 1.4498-1.4558 [23]. This might be due to the higher composition of along chain fatty acid found in the camel milk butterfat than cow milk butterfat[23]. The total solid content of camel milk butter is 64-65% [24], which is lower than this finding, while the total solid contents cow milk butter is in line to the report of [25].

Table 2 . Chemical composition of butter made from camel milk blended with cow milk

| Parameters | Treatments(Mean±SD) | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 |
| Fat (%) | $55.6350^{a}$±0.05 | $61.7500^{b}$±2.2 | $69.3750^{c}$±0.93 | $69.100^{c}$±0.84 | $69.100^{c}$±0.00 |
| pH | $4.6400^{c}$±0.05 | $4.4600^{b}$±0.02 | $4.500^{b}$±0.52 | $4.5650^{b}$±0.12 | $4.1725^{a}$±0.06 |
| MP | $43.2500^{c}$±1.70 | $42.500^{c}$±0.83 | $40.9500^{b}$±0.50 | $41.4250^{b}$±0.42 | $38.700^{a}$±0.16 |
| RI | $1.4550^{ab}$±0.000 | $1.4561^{b}$±0.01 | $1.464^{b}$±0.001 | $1.4515^{a}$±0.00 | $1.4516^{a}$±0.00 |
| ADV(%O.A) | $7.2500^{d}$±0.78 | $6.2500^{c}$±0.65 | $2.5750^{b}$±0.22 | $1.7875^{a}$±0.14 | $2.900^{e}$±0.22 |
| TS | 63.6700±3.28 | 68.8250±1.42 | 76.470±1.28 | 77.2500±1.32 | 75.500±0.00 |

*MR = melting point; RI = refractive index; ADV(%O.A) = acid degree value % of oleic acid; T1 = 100% camel milk type; T2 = 75% camel+25% cow milk type; T3 = 50% camel+50% cowt milk type; T4 = 25% camel+75% cow milk type and T5 = control (100% cow milk); Means with different superscript letters in a row are significantly different ($P<0.001$); values in the table are means±SD of three replications; ADV = acid degree value.

## 4. Conclusion and Recommendation

The present study concluded that blending of camel milk with cow milk could be improved the processing properties of camel milk for butter making. The blend of milk brought the significant improvement in physicochemical properties of butter, churning time of milk, fermentation process and efficiency of fat recovery from the milk. The present of cow milk in the blend made the butter to have a great sound in over all acceptances of butter. However further investigation should be conducted to study the effect of blending cow milk with camel milk on butter fat recovery and efficiency of butter processing within the shorter periods of time that related to cow milk via implementation of advanced techniques of camel milk processing.

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