Chemical properties of buffalo milk from Sianok Village, Agam District, West Sumatera, Indonesia

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Abstract. Buffalo milk is widely available in West Sumatera, Indonesia, which is processed as a traditional food ingredient, so it is necessary to understand its nutritional content. This study aimed to determine the chemical properties of buffalo milk. The measured variables were protein, fat, moisture, pH, and titratable acid. The research method was a descriptive method and analysis in the laboratory. The sample used was taken from four breeders with different lactation types, including 3rd, 4th, 5th, and 6th lactation. This sample was taken in Agam Regency, West Sumatera, Indonesia. The results showed that the nutrition composition of buffalo milk is: protein content of 1.99% - 6.55%, fat content of 2.40% - 15.29%, moisture content of 73.07% - 91.20%, pH of 5.9 - 6.4 and titratable acid of 0.50% - 0.58%. The conclusion is that buffalo milk has good nutritional quality.

1. Introduction
Food is a basic human need. One of the most popular and often consumed food ingredients is milk. Milk comes from the milking of cows or other livestock completely when the cattle are lactating, colostrum is not included, and there is no treatment whatsoever, whether the addition or reduction of a component [1]. Milk contains organic materials such as fat, protein, lactose, and various other vitamins needed by the human body. One of the kinds of milk consumed by the people of West Sumatra is buffalo milk. One area that produces a lot of buffalo milk is Agam Regency. Agam Regency is located at coordinates 00 01'34" - 00 028'43" South Latitude and 99 46'39" – 100 32'50" East Longitude with an area of 2.232.30 km², or equivalent to 5.29% of the scope of West Sumatra province which reaches 42.297.30 km². Agam Regency is an area that has the largest buffalo population in West Sumatra, with 19.764 buffalos in 2017 [2]. Agam Regency also can be used as a traditional food processing business in the form of curd because this area has a very high buffalo population.

Buffalo milk is milk that comes from domesticated buffalo (Bubalus bubalis). Buffalo milk is easily recognized because of its characteristics, namely whiter milk color, rich fat content, and smaller overweight globule size. Buffalo milk production is less than cow's milk. However, the nutritional quality of buffalo milk is higher than cow's milk to be a prospect for a superior product. Buffalo milk has a thicker texture and is more economical when processed. Buffalo milk has a little water content so it is easy to process. Buffalo milk can be drunk by a person who is allergic to cow's milk. It is suitable for people with digestive system disorders. The nutritional content of buffalo milk taken from several
districts in West Sumatra is 7.22-7.83% protein, 7.18-7.88% fat, 80.62-81.03% moisture content, and pH 6.06-6.39 [3]. Aritonang (2017) found that buffalo milk protein was 6.03%, and fat 12.40% [4].

Buffalo milk contains lactic acid bacteria that is potential a probiotic. Probiotics can inhibit pathogenic bacteria so that it can be used as the main ingredient in making curds. The Lactic acid bacteria (LAB) found on the buffalo milk is (Lactobacillus fermentum L23), which could be used as probiotics [5]. Lactic acid bacteria in milk fermentation produces antimicrobial substances that are used as natural antibiotics that can kill pathogens, give health effects to the body, improve the digestive tract, and extend the shelf life of the product [6]. Therefore, it is necessary to test the chemical quality of buffalo milk to be used as the primary material for processing the milk into traditional food, namely dadih.

2. Materials and methods

2.1. Materials
The milk used in this research was 450 ml of buffalo milk obtained from Jorong Sianok and Jorong Sumua, Nagari Sianok, Agam Regency, West Sumatera, Indonesia. Materials that will be used to see the nutritional value of buffalo milk are selenium, H$_2$SO$_4$, 30% NaOH, methyl red indicator, 0.1 N NaOH, rubbing alcohol, benzene, sterile distilled water, phenolphthalein (pp). The equipment used in this study were label paper, porcelain plates, pH meters, electric ovens, analytical scales, Kjeldahl flasks, funnels, distillation flasks, beaker cups and Erlenmeyers, fume hoods, bunsen, hyacinth pipettes, volumetric flasks, a set of soxhlet tools, bunsen, grease paper, and aluminum foil.

2.2. Method
In this research, the type of buffalo taken for milk is the swamp buffalo. This research using a descriptive method and laboratory analysis. Information about the sample is presented in Table 1.

### Table 1. Data on buffalo milk samples

| Sample code | Parentage (years) | Lactation | Calf age (month) | Name of the owner | Address | Documentation |
|-------------|-------------------|-----------|-----------------|-------------------|---------|---------------|
| SKA         | 6                 | 3         | 6               | Mulyadi           | Jorong Sianok |
| SKB         | 6                 | 4         | 3               | Nasrun            | Jorong Sumua |
| SKC         | 9                 | 5         | 4               | Barniwiati        | Jorong Sianok |
| SKD         | 12                | 6         | 4               | Sutan Pangeran    | Jorong Sumua |

2.3. Measured variables

2.3.1. Protein. The value of protein content of buffalo milk is determined based on the guidelines of Sudarmadji, Haryono, and Suhardi, using the Kjeldahl method with the following work procedures [7]:

- Destructive stage. The dried buffalo milk sample was taken 1 g, then put in a Kjeldahl flask, then added 1 g of selenium catalyst and 25 ml of concentrated H$_2$SO$_4$ and heated until destruction occurred.
- The distillation stage. The solution was transferred to a 500 ml volumetric flask and then diluted with distilled water to mark the line. Then take 25 ml of sample solution plus 25 ml of 30% NaOH, which has been mixed with 150 ml of aquadest, and put it in a distillation flask.
The solution is heated (2/3 lost) until all N from the liquid in the flask is captured by $\text{H}_2\text{SO}_4$ 0.05 N, which is first mixed with methyl red indicator drops and Erlenmeyer.

- **Titration stage.** Erlenmeyer containing the distillate was titrated with NaOH 0.01N (Z ml). In another, Erlenmeyer added 25 ml of 0.05 N $\text{H}_2\text{SO}_4$ and three drops of red methyl indicator and titrated with 0.1 NaOH so that the color change from pink to yellow as blank (Y ml).

### 2.3.2. Fat

Calculating the fat content of buffalo milk was determined by the Soxhlet method, with the following work steps [7]:

- The sample that has been dried as much as 1 g is wrapped in grease paper and then dried in an electric oven for 12 hours at 105 °C
- The packages are weighed hot then extracted with benzene for 4-6 hours until the benzene in Soxhlet becomes clear
- The extraction is stopped while the sample is cooled to dry, where the benzene will evaporate
- The sample is dried in an electric oven at 105 °C for 4 hours to obtain a constant weight
- The packages are weighed one by one when hot. The weight difference before and after extraction is the weight of fat in the food.

### 2.3.3. Moisture content

The sample's water content was determined based on the guidelines of Sudarmadji et al. (1996) [7]. The aluminum plates were oven-dried at 110 °C for 1 hour and then cooled in a desiccator. After that, the plates were weighed and filled with a sample of 5 g and then dried in an oven at 105 °C for 8 hours. Then it is cooled in a desiccator and weighed then carried out repeatedly until the weight becomes constant.

### 2.3.4. pH

The pH value of buffalo milk can be observed based on the guidelines of (Apriantono, Fardiaz, Puspitasari, Sedarnawati, and Budiyananto, 1989) as follows [8]:

- The sample is weighed as much as 50 ml and put into a beaker glass
- The pH meter is standardized using a standard buffer solution with a pH of 7 (sterile distilled water).
- The electrode is immersed in the beaker glass which contains the sample.
- pH readings are done after the pH meter scale has stabilized

### 2.3.5. Acidity

Measurement of sample acidity was carried out according to the 1995 AOAC guidelines [9]. The sample was weighed using a 5 ml analytical scale, then stirred using a stirring rod until the sample was homogeneous with aquades. The prepared biuret was filled with 0.1 N NaOH, then added phenolphthalein (pp) indicator as much as 2 ml. Titrate with 0.1 N NaOH until there is a change in color (equivalent point) and the volume used by the titration is recorded and finally, the calculation is done using the formula.

### 3. Results and discussion

#### 3.1. Proximate analysis of buffalo milk

This analysis is aimed at obtaining the nutritional value of buffalo milk. Included in this is a test protein, fat, moisture content, pH, and titratable acid (TTA). The proximate test results of buffalo milk can be seen in the table 2.
Table 2. Average score of proximate tests of buffalo milk

| Sample code | Protein content (%) | Fat level (%) | Moisture (%) | pH | TTA (%) |
|-------------|---------------------|--------------|--------------|----|---------|
| SKA         | 6.55                | 15.29        | 73.07        | 6.0| 0.58    |
| SKB         | 2.08                | 7.60         | 85.34        | 5.9| 0.54    |
| SKC         | 1.99                | 2.40         | 91.20        | 6.2| 0.54    |
| SKD         | 3.08                | 6.28         | 85.93        | 6.4| 0.50    |

SKA (the 3rd lactation buffalo milk from Jorong Sianok), SKB (the 4th lactation buffalo milk from Jorong Sumua), SKC (the 5th lactation buffalo milk from Jorong Sianok) and SKD (the 6th lactation buffalo milk from Jorong Sumua)

3.1.1. Protein. The results of laboratory analysis, it was found that the protein content of buffalo milk with the SKA code was 6.55%, the SKB code was 2.08%, the SKC code was 1.99% and the SKD code was 3.08%. The high and low nutritional value of milk is influenced by the feed given. Feed is an important aspect of the buffalo livestock business because it will determine its survival. This feed can be in the form of forage or concentrate and is very influential on the nutrition of milk so that it will affect the quality of the milk produced. Feed containing carbohydrates, when in the rumen, will be converted into volatile fatty acid (VFA). VFA is then broken down into acetate, butyrate, and propionate. The higher the propionate level, the higher the glucose level, causing higher lactose levels, which is then broken down into acetate, butyrate, and propionate. The higher the propionate level, the higher the glucose level, causing higher lactose levels, and higher milk production [10]. The highest protein content is found in buffalo milk with the SKA code, namely 6.55%. This is because the feed given to lactating buffaloes is a legume in the form of gamal (Gliricidia sepium), The crude protein content of gamal leaves ranges from 20.28% - 25.52% and undigested nutrients ranges from 58.45% - 69.73%; it makes this plant good for ruminants. Gamal as animal feed can be given as a single forage source. This plant is also good as a complement to the protein needs of livestock given grass feed. So the protein in buffalo milk is higher. The quality of milk protein is influenced by the ratio of quality legume grass and concentrate [11]. Besides, the protein content of SKA buffalo milk is also influenced by the frequency of forage feed twice a day regularly.

The low protein of SKC coded buffalo milk is influenced by poor feeding, in which buffalo are only grazed in the fields and given forage once a day. The type of forage given is elephant grass (Pennisetum purpureum). Elephant grass contains nutrients in the form of 20.29% dry matter, 6.26% crude protein, 2.06% fat, 32.60% crude fiber, 9.12% ash. BETN 41.82%, calcium 0.46%, and phosphorus 0.37% [12]. Poor feeding will affect the milk quality of buffalo. The rearing system for lactating buffalo is an extensive method in which the buffalo are only released. The age of the buffalo has reached seven years. The high and low levels of buffalo milk protein can be influenced by several factors, including internal and external factors. Internal factors come from within the livestock, such as age, breed, and genetics. In contrast, external factors come from the environment such as climate, temperature, feed, lactation period, and maintenance management. There are several factors affect the quality of milk, including cleanliness, milk characteristics, and milk composition [4]. The protein content of milk varies depending on the nation, disease, lactation level, milk production, quantity, and quality of feed and protein content in the feed [13]. As seen in the research results, the protein content of SKC buffalo milk was 1.99%. The nutritional value of buffalo milk is not affected by the lactation period. The nutritional value of milk is not affected by the level of lactation [14].

The results obtained were not much different from Aritonang's research, which found buffalo milk protein content of 6.03% [4]. Nevertheless, lower than Melia's research who obtained buffalo milk protein of 6.77% [5]. In general, buffalo milk protein content in West Sumatra ranges from 7.22% - 7.83% [3].
Fat. The results of laboratory analysis, it was found that the fat content of buffalo milk ranged from 2.40% - 15.29%. The highest fat content was found in SKA coded buffalo milk, and the lowest fat content was found in SKC coded buffalo milk. SKA buffalo milk has the highest fat content (314th lactation) is because most of the feed given is forage with good quality. Forage feed will increase the synthesis of fatty acids, thereby increasing levels of milk fat. Forage plants contain a lot of acetic acid, which is the raw material for the synthesis of fatty acids. The more acetic acid that is synthesized, the higher the fatty acid, so that the fat concentration will be higher too. Forage feed given to livestock can increase milk fat because crude fiber is fermented in the rumen by microbes, which produce acetic acids as the main component of milk fat [15]. While the low fat of SKC buffalo milk is caused by poor feeding, buffalo are only given additional forage once a day. Milk fat content is also influenced by the crude fiber content in the ration. If the ration of crude fiber content is low, it will reduce the value of fat content of milk [16].

Milk fat content is not influenced by the amount of buffalo lactation. However, the high and low levels of milk fat are influenced by the milking time in the afternoon, and the fat content is higher than in the morning. The level of lactation does not affect milk quality [14]. The different composition of milk is caused by differences in the type of livestock, heredity, feed given, maintenance management, milking procedures, and the surrounding environment [17]. The cattle fed with additional concentrates would lower the milk fat content. At the same time, livestock that was only given forage had higher milk fat content [18]. The results obtained were not much different from Aritonang's research (2017), which found that buffalo milk fat content was 12.40% [4]. The range of fat content in buffalo milk in West Sumatra is between 7.18% - 7.88% [3].

Moisture. The results obtained in calculating the moisture content of buffalo milk ranged from 73.07% - 91.20%. This is similar to the research result from Han et al. (2012) that in his research was found buffalo milk content contained about 83% [19]. The highest moisture of buffalo milk is found in SKC (lactation 5) because the high moisture is inversely proportional to the protein content and fat content, the SKC milk has a lower fat content and protein content compared to other buffalo milk. Water content is closely related to fat content, where the higher the water content, the lower the fat content [20].

Another factor affecting the milk content is the type and amount of feed given. The physical and chemical quality of milk is influenced by feeding, feed, milking frequency, dairy breed, season, milking method, and the location when lactation [21]. There are differences in the water content of all breeders due to differences in age, genetics, composition, and scope of the feed given and the period of lactation. The production and design of milk are influenced by several factors such as type of livestock (race/species), heredity (heredity), nutrition or animal feed, environment, and milking procedures [17]. This study's results are not much different from Aritonang's research (2017), which found that the moisture content of buffalo milk was 77.35% [4]. In West Sumatera, buffalo milk moisture content ranges from 80.62% - 81.03% [3].

pH. The pH value of buffalo milk from Agam ranges from 5.9 - 6.4. Indonesian National Standard (INS) Number 01-3141-1998 regarding the quality requirement for fresh milk, namely the pH of milk ranges from 6-7. If the pH of milk is higher than the standard limit it is usually due to mastitis. Meanwhile, if it is below 6.5, it is usually caused by bacteria or the milk is milk colostrum [22]. The
thing that affects the pH value of buffalo milk is long storage: the longer the storage time, the lower the pH value [23]. The increase and decrease in milk’s pH are caused by the conversion from lactose to lactic acid by microorganisms and enzymatic activity [24]. A decrease in pH occurs along with an increase in lactic acid bacteria [25]. The pH of fresh milk ranged from 5.3 to 6.0 [26]. In general, the pH value of buffalo milk in West Sumatera ranges from 6.06 - 6.39 [5]. The results obtained also meet the SNI No. 01-3141-1998, namely the pH of buffalo milk 6-7.

3.1.5. Titratable acid (TTA). The acidity level of buffalo milk ranges from 0.50% - 0.58%. The difference in the acidity level of buffalo milk is caused by acidic compounds such as lactic acid, citric acid, amino acids, and carbon dioxide, which dissolve in milk. Lactic acid is an acid that mostly found in milk [26]. The higher acid, the LAB activity to convert lactose into organic acids, is higher, marked by a pH [27].

4. Conclusions
The results of the research showed that the composition of nutrition buffalo milk is the protein content range between 1.99% - 6.55%, fat content 2.40% - 15.29%, moisture content 73.07% - 91.20%, pH 5.9 – 6.4 and titratable acid (TTA) 0.50% - 0.58%. The conclusion of this study is buffalo milk has good nutritional quality value.

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