SCIREA Journal of Animal Husbandry and Veterinary Medicine
http://www.scirea.org/journal/AHVM
April 9, 2023
Volume 5, Issue 1, February 2023
https://doi.org/10.54647/ahvm230036

Chemical Characteristics of Ettawa Crossbreed Goat Milk Fed the Ration Contain of Soybean Oil Calcium Soap

Ali Bain[1], Nur Santy Asminaya*[,1], Arby'in Pratiwi[1], Michala Michala[2]

[1]Animal Science Faculty, University of Halu Oleo, Kampus Hijau Bumi Tridharma Anduonohu. Jl. H.E.A. Mokodompit – Kendari – Sulawesi Tenggara

[2]Dakwah and Communication Faculty, Islamic Institute Bunga Bangsa Cirebon, Jl. Widarasari III – Cirebon – West Java

*Email: nur.asminaya@uho.ac.id

Abstract.

This study aimed to determine milk quality of local Southeast Sulawesi female Ettawa crossbreed (EC) goats which fed calcium soap soybean oil (CaS-soybean oil) in the ration. This study used 4 lactating female local EC goats from Southeast Sulawesi with a weight of 24-33 kg. The experimental design used was the Latin Square Design (LSD) with 4 treatments and 4 replications. The treatments consisted of T1 (ration without CaS_soybean oil (control), T2 (concentrate containing 1.5% CaS soybean oil, T3 (concentrate containing 3.0% CaS_soybean oil, and T4 (concentrate containing 4.5% CaS_soybean oil). Data were analyzed by using Krusskal Wallis one way ANOVA and Mann-Whitney U tests. The observed variables were contents of protein, fat, lactose, dry matter (DM) and solid non-fat (SNF) The results showed that-protein, fat, dry matter and solid non-fat were significantly different-but lactose did not significantly different. The quality of local female EC goat milk in Southeast

Sulawesi that is fat, protein, lactose contents was categorized in good quality according to Thai Agriculture Standard (TAS) No 6006-2008. The conclusion of this study was the administration of 4.5% CaS_soybean oil showed better milk quality than other treatment on lactating local female EC goat.

Keywords: Ettawa Crossbreed Goat, Soybean Oil Calcium Soap (SCa-soybean), milk quality

1. Introduction

Ettawa crossbreed goat (EC) is a type of dual-purpose goat, a livestock that can produce both meat and milk. Goat milk has superior nutritional content. Fat and protein in goat's milk are also easier to digest and contain higher levels of vitamin B1 than cow milk. However, low goat milk production is influenced by the genetic quality of the livestock itself, the age of the female parent, lactation duration, udder size, short milking intervals, poor maintenance management, such as stable management that is still not optimal and feeding that only utilizes field grass as the main feed, which results in the nutritional needs of livestock not being met, both for production and reproduction. The low milk production can result in losses for EC goat breeders. Therefore, to support the production performance of EC goats, better management of feeding in terms of quality according to the physiological needs of the livestock needs to be improved, one of which is by improving the quality of the nutritional content of the feed. Feed greatly affects livestock productivity. Ruminant feed consists of forage containing high fibre as the main feed and concentrate as a booster feed. Concentrate is feed that is easily digested and contains nutrients that are good for livestock productivity, but its administration must be limited because it is expensive and contains fatty acids which if given in excess will interfere with the digestive process in the rumen. Utilization of feed from agricultural and plantation industrial waste is an alternative to reduce the cost of feed paid by farmers. In addition, the use of feed ingredients containing high energy density such as vegetable oil is expected to support livestock productivity. The use of high energy density feed ingredients such as fats or vegetable oils continues to be developed in the beef cattle industry.

Vegetable oil supplementation with polyunsaturated fatty acids in feed is not only aimed at increasing consumption and energy use efficiency but is also expected to increase the content of polyunsaturated fatty acids (PUFA) in ruminant meat and milk products [1]. The use of vegetable oils as an energy source and PUFA is faced with the negative effects of PUFA on microbes and the rumen ecosystem which can have implications for the production performance of ruminants. One of the feed methods to reduce the negative impact of polyunsaturated fatty acid (PUFA) in soybean oil on the digestive process of ruminant is through modification of its feeding with fatty acid calcium soap technology [2]. The addition of feed ingredients containing high PUFA is expected to improve milk production performance and PUFA content in milk [3]. This study was conducted to evaluate the effectiveness of using soybean oil calcium soap (CaS soybean oil) in feed on the production performance of local female EC goats in Southeast Sulawesi.

2. Materials and methods

2.1. Material

Milk samples from local female EC goats from Southeast Sulawesi with a body weight of 24-33 kg. The feed ingredients used consisted of 60% forage, namely odot grass (*Pennisetum purpureum* Cv.Mott) and concentrate (cassava, fine rice bran, coconut cake, molasses, CaCO3, urea, pollard and CaS_soybean oil). The tools used include a milk analyzer (Master Pro Milk tester, Bulgaria), lactodensimeter, pH meter, cup, tube, laminar, incubator. The livestock used were 4 lactating female EC goats The materials used for the chemical analysis of milk consisted of fresh milk and distilled water.

2.2. Methods

2.2.1. Making Calcium Soap-Soybean Oil (CaS_soybean oil)

The process of making CaS-soybean oil was carried out by following [3] as follows: 1). NaOH 566 g was dissolved in distilled water until the volume of the solution in a plastic bucket was 5.5 litres. 2). CaCl2 964 g dissolved in 1.5 litres of distilled water. 3). 4.1 kg of oil was heated in the reactor tube. 4). The prepared NaOH solution was slowly introduced into the reactor containing heated oil. 5). The reactor stirrer was run for 30 minutes with 1000 rpm rotation until the oil and NaOH solution dissolved completely at 238 0C. 6). The solution of oil and NaOH was poured from the reactor into the stirring tube of the soy calcium soap product. 7). The compactor unit was closed and the mixer was turned on. $CaCl_2$ solution was dripped until a mixture of oil, NaOH and CaCl2 solution formed a solid product. 8). The mixer in the stirrer tube was continuously turned on until the product was crushed to form a powder. 9). If there was excess water during the compaction process, the water was discarded. The calcium soap powder was removed from the mixing tube and stored in a stainless-steel container. 10). Calcium soap products were put in a 1 kg package and then stored in the freezer to avoid the oxidation process.

2.1.1. Making Treatment Feed

The ration were used consisted of 60% forage and 40% concentrate. The forage used was odot grass, which was cultivated around the land of the Faculty of Animal Science Halu Oleo University. The concentrate used was composed of ingredients: cassava, fine rice bran, coconut cake, molasses, CaCO3, urea and CaS_soybean oil which were mixed manually and then followed by an electric-powered feed mixer with a capacity of 50 kg. Feed mixing was done by starting with small portions of feed ingredients and followed by mixing large portions of feed ingredients. Mixing was carried out until evenly mixed [4].

2.1.2. Milk Production

Milk production was the result of the production of each experimental animal in the morning and evening measurements after milking. Milking was done every 07.00-08.00 WITA (UTC+08:00) and in the afternoon 17.00-18.00 WITA. Milk production was measured using a measuring cup, after which 50-100 ml of milk samples were taken from each research animal to analyse its chemical quality which included protein, fat, lactose, dry matter (DM) and solid non-fat (SNF).

2.1.3. Parameters Measurement

Fresh milk testing was done with the Master Pro Milkoester. Milk samples were prepared as much as ± 50 ml and put into a measuring cup. The Master Pro Milkoester tool was turned on by pressing the on button and there would be an option for selecting the quality test of livestock milk, then selecting the choice of goats. The tool was ready to use. The milk sample that had been prepared earlier, was inserted into the small pipe that was already available on the tool. The tube would help the milk sample into the device. It will take some time for the device to detect the chemical composition of the milk. After that, the results of the analysis of the chemical composition of the milk would appear on the display screen including tests for fat, protein, lactose, dry matter (DM) and solid non-fat (SNF). Furthermore, the small pipe was sterilized with distilled water and then tested again with the same thing on the next sample [5]. Test of Dry Matter (DM) and solid non-fat (SNF) Content. The dry matter can be calculated using the formula [6] as follows:

$$DM = NFDM\ (\%) - FL \quad (2)$$

Notes: FL = Fat Level (in % DM) = Dry Matter

The data were analysed using the Latin Square Design. If the treatment had a significant effect, it would be continued with Duncan with the help of a software program SPSS 23 (Statistic Package for the Social Sciences) [7].

3. Results and Discussion

3.1.1. Milk Protein

The quality of milk obtained from the study can be seen from several parameters, one of which is protein. The results showed that the addition of SCa-soybean at different levels had a significant effect (P<0.05) on milk protein content (Table 1). Further test results showed that P1 (4.03%) was not significantly different P3 (4.19%) and P4 (4.03%), but significantly different (lower) (P<0.05) compared to P2 (4.30%). Milk protein content ranged from 4.03-4.30%, the highest protein content was in treatment P2 (4.30%) and the lowest was in treatment P1 (4.03%), P2 (4.30%) and P4 (4.03%). The protein content of milk in this study was higher than [8] which was 3.43% and [9] which was 2.80% without the use of calcium fatty acid in dairy cows, while with the use of calcium fatty acid it was 2.85%. In general, the milk protein level obtained in this study was classified to be in very good milk protein range. This meant that the feed containing SCa-soybean was able to contribute or influence the genetic potential in producing optimal milk protein levels. This is in accordance with the report [10] that the protein level of milk was influenced by breed, pregnancy duration, body size, oestrus, age, calving interval, dry period of the stable, milking frequency, feed, maintenance management and lactation period.

3.1.2. Milk Fat

The addition of of SCa-soy at different levels had a significant effect (P<0.05) on the average fat level of EC goat milk (Table 1). Further test results showed that the mean fat content of EC goat milk treated with P1 (6.96%) was significantly different (P<0.05) with P2 (7.00%), P3 (7.65%) and P4 (7.14%). The highest milk fat was obtained in all treatments with CaS soybean oil administration, while the lowest occurred in the control treatment. Milk fat content in this study had met the standards of SNI (Indonesian National Standard) 2011 and Thai Agricultural Standard (TAS) 2008 which was 3.0% and above 4.0%. Research shows that the use of SCa-soy levels up to 4.5% given in concentrate tended to increase the fat level of EC goat milk. This was assumed to be due to the influence of SCa-soy fatty acid content or protected feed fat from soybean oil. that soybean oil was one of the oils that contains quite high polyunsaturated fatty acids around ±84.6% consisting of 23.3% oleic acid, 53.7% linoleic acid and 7.6% linolenic acid. Milk fat content in each treatment in this study (6.96-7.65%) was higher than the study [11] (5.98-6.13%) who were fed the same forage and concentrate diet and (6.29%) who were given basal diet. Milk fat content ranged from 6.96-7.65%. [12] added that CaS soybean oil was a form of protected fat and an effective source of fat as an energy source for ruminants.

3.1.3. Milk Lactose

The addition of SCa-soybean at different levels had no significant effect on the lactose level of EC goat milk given each treatment (Table 1). The lactose level of EC goat milk ranged from 4.45-4.79%. The results of this study are higher than between 2.59-2.89% [12]. Very high levels of lactose in certain studies were closely related to the effect of of CaS soybean oil supplementation as a source of energy and minerals in this study. Milk lactose is a milk carbohydrate that is synthesized in the udder. The main ingredient for the formation of lactose in milk is blood glucose, which reaches 80% [13]. The process of lactose formation in the udder gland is not the same as other cells, as it is not affected by blood insulin concentrations. The lactose level of milk is relatively constant but lactose production increases in line with the increase in milk production. Fluctuations in lactose content according to the dynamics of milk production during lactation [14]. The main component of milk carbohydrates is mostly lactose, which is formed from glucose and galactose molecules. The main precursor of lactose is blood glucose. In the mammary gland, glucose molecules are phosphorylated from glucose 6-phosphate to glucose 1-phosphate form. Glucose 1-phosphate together with uridine triphosphate (UTP) to form glucose diphosphate (UDP); UDP glucose is then converted to UDP galactose; UDP glucose combines with free glycose to form lactose with the release of UDP. Furthermore, lactose synthesis is catalysed by the enzyme lactose [15]. In ruminants, the concentration of glucose in the circulating system is derived from the extraction of propionate in the liver [16]. Normal lactose is only found in milk, which is a kind of disaccharide made from glucose from food. The use of lactose for the body is the same as other carbohydrates, but it must first be broken down into glucose and galactose by the lactase enzyme from the digestive tract [17]. Research [18] [19] reported the lactose content of goat milk was 2.76%. While EC goat milk contains 4.05% lactose [20].

3.1.4. Dry Matter (DM)

The addition of SCa-soybean at different levels had a significant effect ($P<0.05$) on the dry matter of milk (Table 1). DM levels in milk ranged from 14.35-14.86%, where the highest DM in milk was obtained in treatment P3 (14.86%). Further test results showed that P3 (14.86%) was not significantly different from P2 (14.75%), but significantly different from P4 (14.41%) and P1 (14.35%). However, the total dry matter content had met the SNI (2011) standard, which was a minimum of 10.8%. Milk DM consisted of SNF and milk fat [21]. Milk fat level was influenced by milk DM level; if milk fat levels were high then milk DM levels would be high, as some milk DM content consisted of milk fat, while the rest were lactose, protein, minerals and vitamins which were included in SNF [22]. [23] The components of milk were influenced by the pattern of fermentation carried out by rumen microbes, so it was necessary to create or provide optimal conditions for the life of microorganisms in the rumen. Fatty acid calcium soap is one of the chemical PUFA protection methods that is resistant to rumen digestion and is able to suppress the negative effects of PUFA fatty acids so as not to interfere with the fermentation process in the rumen [24]. If this can be controlled and done properly, the use of vegetable oils containing high PUFA could have positive implications in improving productivity and quality of ruminant fat products [25].

3.1.5. Solid Non-Fat (SNF)

The addition of of SCa-soy at different levels had a significant effect ($P<0.05$) on the milk's SNF (Table 1). Further test results showed that P2 (7.7%) was significantly different from P1 (7.40%), P3 (7.21%) and P4 (7.25%). This was assumed to be due to the high levels of lactose and milk protein. This was in line with [26] that SNF of milk was influenced by lactose, protein and good feed quality, which tended to increase the SNF level of milk. The results of SNF in this study were lower than those of [27]. i.e., 10.29-11.09%. This was presumably due to differences in feeding containing tofu dregs, where tofu dregs were a protein source feed that can increase milk SNF levels. Milk SNF levels in this study ranged from 7.21-7.76%, where the highest SNF was obtained in treatment P2 (7.76%) and the lowest was in treatment P3 (7.21%). Another study reported that goat milk's SNF ranged from 8.75-9.57%, then [28].

Stated the SNF component was 9.65%, next [29] stated that in different feeding the EC goats produced milk components in the form of SNF ranging from 9.44-9.86%.

Table 1. Milk Quality of EC Goat Milk

Treatment	Milk Quality (%)				P value
	P1	P2	P3	P4	
Protein	4.03±0.03^{b}	4.30±0.22^{a}	4.19±0.17^{ab}	4.03±0.05^{b}	0.02
Fat	6.96±0.11 ^{a}	7.00±0.24 ^{b}	7.65±0.51 ^{b}	7.14±0.20 ^{b}	0.01
Lactose	4.45±0.04	4.79±0.32	4.71±0.24	4.50±0.07	0.06
Dry Matter	14.35±0.05^{c}	14.75±0.24^{ab}	14.86±0.47^{a}	14.41±0.07^{bc}	0.03
Non-Fat Dry Matter	7.40±0.09^{b}	7.76±0.09^{a}	7.21±0.24^{b}	7.25±0.17^{b}	0.01

Different superscripts on the same line show significant differences ($P<0.05$): P1 (Concentrate without CaS_soybean oil (control); P2 = concentrate containing 1.5% CaS_soybean oil; P3 = concentrate containing 3.0% CaSsoy; P4 = concentrate Containing 4.5% CaS_soybean oil.

4. Conclusions

The use of of SCa-soy can increase the chemical quality of lactating local EC goat from Southeast Sulawesi which can be seen from the increase of protein, fat, DM, and SNF milk.

References

[1] Kiani S, van Ruth S M, van Raamsdonk L W D and Minaei S 2019 Hyperspectral imaging as a novel system for the authentication of spices: A nutmeg case study Lwt 104 61–9

[2] Kumar, R., K. Sivaiah, R. Y. Ramana, B. Ekambram, T. J. Reddy & Reddy 2006 Effect of supplementation of dietary protected lipids on intake and nutrient utilization in Deccani lambs. Trop. Anim Health Prod. 38 : 151-158

[3] Milkotester 2017 Opening Intruction Milk Analizing Device: Master Pro.http://www.milkotester.com/data/MasterPro.pdf. (Diakses tanggal 09 Februari 2021).Evans W C, Evans D and Trease G E 2009 Trease and Evans pharmacognosy (Saunders/Elsevier)

[4] Sudarwanto, M. 2012. Pegangan Pemeriksaan Susu Dan Produk Olahannya, Institut Pertanian Bogor, Bogor. Pr. 31-81. Paulus E and Suryani M 2019 Image analysis for smart machine of nutmeg sorting J. Phys. Conf. Ser. 1196

[5] Herispon, H 2020 Modul Olah Data Dengan SPSS 23. Sekolah Tinggi Ilmu Ekonomi Riau Press. Pekanbaru. 1-40 Perhimpunan Teknik Pertanian Indonesia L, Suyantohadi A and Fallah M A F 2012 Jurnal keteknikan pertanian 26

[6] Asminaya, N. S 2007 Penggunaan ransum komplit berbasis sampah sayuran pasar untuk produksi dan komposisi susu kambing perah. Tesis, Program Pascasarjana, Institut Pertanian Bogor, Bogor.

[7] Wina, E. & I. W. R. Susana 2013 Manfaat lemak terproteksi untuk meningkatkan produksi dan reproduksi ternak ruminansia. Wartazo. 23 (4): 176-184

[8] Nurdin, E 2016 Ternak Perah Dan Prospek Pengembangannya. Plantasia, Yogyakarta. Nasution I S 2017 Non-Destructive Measurement for Estimating Leaf Area of Bellis perennis Rona Tek. Pertan. 10 58–64

[9] Bain, A., D. A. Astuti, S. Suharti, C. Arman & I. K. G. Wiryawan 2016 Performance nutrient digestibility, and meat quality of bali cattle fed a ration supplemented with soybean oil calcium soap and cashew fruit flour. Media Peternakan, 39 (3): 180-188

[10] Bain, A., I. K. G. Wiryawan, D. A. Astuti, C. Arman & S. Suharti 2017 Fermentability and digestibility of ration supplemented with soybean oil calcium soap and cashew fruit flour. Pakitan jurnal of nutrition. ISSN 1680-5194. 16 (12): 94-95

[11] Bain, A., I. K. G. Wiryawan, D. A. Astuti, C. Arman & S. Suharti 2018 Optimalisasi penggunaan level sabun kalsium minyak kedelai dalam ransum terhadap karakteristik fermentasi, populasi mikroba dan kecernaan nutrient secara in vitro menggunakan cairan rumen sapi bali. FNasution I S 2018 Technical optimization of a laser marking process of banana fruits and poinsettia bracts (Gottfried Wilhelm Leibniz Universität Hannover)

[12] Ramadhan, B. G., T. H. Suprayogi & A. Sustiyah 2013 Tampilan produksi susu dan kadar lemak susu kambing peranakan ettawa akibat pemberian pakan dengan imbangan hijauan dan konsentrat yang berbeda. Fakultas Peternakan, Universitas Diponegoro, Semarang. 2 (1): 353-361.

[13] Tanuwira, U. H., D. C. Budinuryanto, S. Darodjah & W. S. Putranto 2011 Studi pembuatan kompleks mineral minyak dan efek penggunaannya dalam ransum terhadap fermentabilitas dan kecernaan (in vitrio). Fakultas Peternakan, Universitas Padjajaran, Jatinangor. 10 (1): 32-38.

[14] [TAS] Thai Agricultural Standar 2008 Raw Goat Milk. National bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperative. Vol. 125, Section 139 D. Thailand

[15] Schalm, D. W., E. J. Carrot & N. J. Jain 1971 Bovine Mastitis Philadelphia: Lea and Febinegr. Schmidt, G. H. 1971. Biology Of Lactation. Freeman and Company. San Franscisco

[16] Soleimanipour A, Chegini G R and Massah J 2018 Classification of anthurium flowers using combination of PCA, LDA and support vector machine Agric. Eng. Int. CIGR J. 20 219–28

[17] Hertaviani, R. F. 2009. Kandungan Nutrisi dan Kadar Laktoferin dalam Susu Kambing Perah Bangsa Peranakan Ettawa (Pe) dan Jawarandu. Skripsi. Fakultas Peternakan, Institut Pertanian Bogor. Bogor.

[18] Heuze, V., G. Tran, S. G. Reverdin & F. Lebas. 2016. Elephant grass (Pennisetum purpureum). Feedipedia a programe by INRA, CIRAD, AFZ and FAO. (Diakses tanggal 14 April 2020).

[19] Prawesthrini, S., P. S. Hario, A. T. Soelieh, E. Mustofa, H. E. Nenny, H. Garry, C. D. V. Budiarto & K. S. Sabdoningrum 2010 Fakultas Kedokteran Hewan, Universitas Airlangga, Surabaya.

[20] Agustina, Y., Mulyo, J. H., & Waluyati, R. (2020). Analisis Pengendalian Mutu Bahan Baku Utama Susu Kambing Bubuk di Bumiku Hijau Yogyakarta. Jurnal Teknosains, 9 (2) (Juni), 91–180.

[21] B., & Umberger, W. J. (2012). Factors Influencing Malaysian Consumers' Consumption of Dairy Products. Australia Agricultural and Resource Economics Society, 1(1), 1–30.

[22] Bytyqi, N., Muji, S., & Rexhepi, A. (2020). Consumer Behavior for Milk and Dairy Products as Daily Consumption Products in Every Household—The Case of Kosovo. Open Journal of Business and Management, 08(02), 997–1003. https://doi.org/10.4236/ojbm.2020.82063.

[23] Fanani, Z., & Thohari, I. (2018). Preferensi Konsumen Produk Kefir Susu Kambing Di Malang. Jurnal Nusantara Aplikasi Manajemen Bisnis, 3(1), 54. https://doi.org/10.29407/nusamba.v3i1.12029

[24] Guney, I., & Ocak, S. (2013). Consumer Preference for Goat Milk in Turkey Consumer Preference for Goat Milk in Turkey. Global Advanced Research Journal of Agricultural Science, 2(7), 181–188.

[25] Hidayat, A. T., Mustikasari Elita, F., & Setiaman, A. (2012). Hubungan Antara Atribut Produk Dengan Minat Beli Konsumen. EJurnal Mahasiswa Universitas Padjajaran, 1(1), 19. http://journals.unpad.ac.id

[26] Holmes, R., Hayes, J., Matthaei, C., Closs, G., Williams, M., & Goodwin, E 2016 Riparian Management Affects Instream Habitat Condition in a Dairy Stream Catchment. New Zealand Journal of Marine and Freshwater Research, 50(4), 581–599.