Muhammad Resthu et al. /Animal Production. 21(3):122–128, 2019
Accredited by Kemenristek Dikti No 32a/E/KPT/2017. ISSN 1411-2027

The Effects of the Oxytocin Hormone Induction on the Value of the Composition of Etawah Crossbred Goat Milk

Muhammad Resthu[1,*], Dzarnisa Araby[1] and Sri Wahyuni[2]

[1]Department of Animal Husbandry, Universitas Syiah Kuala, Banda Aceh, Indonesia
[2]Faculty of Veterinary Science, Universitas Syiah Kuala, Banda Aceh, Indonesia
***Corresponding author email: muhammadresthu@gmail.com**

Abstract. This study aims to see the extent of influence of oxytocin hormone induction on the nutritional composition of milk in the Etawah Crossbred goat. This research was conducted in December 2018 in Syiah Kuala District, Banda Aceh, Indonesia. The examined parameters were the levels of fat, nonfat dry matter (SNF), protein content, lactose content and milk density. The research used 18 Etawah goats and oxytocin hormone. A statistical unpaired t test indicated a highly significant influence on the increase of milk fat injected with oxytocin hormone, i.e. 4.86% or 37.2% or higher than that without hormone injection. The milk density results showeda significant effect on the decrease in goat milk density (28.81%) which was lower by 10.65% from that without hormone treatment. The level of no fat dry matter (SNF), protein content and lactose content had no effect in milk, i.e. 8.39%, 3.91% and 3.76%, respectively. In conclusion, hormone oxytocin injection had a highly significant effect on increasing milk fat levels and significantly affected the decrease in milk density but did not affect the level of nonfat dry matter (SNF), lactose and protein.

Keywords: ettawah crossbred goat, hormone oxytocin, injection, milk composition

Abstrak. Penelitian ini bertujuan untuk melihat sejauh mana pengaruh induksi hormon oksitosin terhadap komposisi gizi susu kambing Peranakan Etawah. Penelitian ini dilakukan pada bulan Desember 2018 di Kabupaten Syiah Kuala, Banda Aceh, Indonesia. Parameter yang diperiksa adalah kadar lemak, bahan kering tanpa lemak (SNF), kadar protein, kadar laktosa dan kepadatan susu. Penelitian ini menggunakan 18 kambing Etawah dan hormon oksitosin. Uji t yang tak berpasangan secara statistik menunjukkan pengaruh yang sangat signifikan terhadap peningkatan lemak susu pada ternak yang disuntikkan dengan hormon oksitosin, yaitu 4,86% atau 37,2% atau lebih tinggi daripada ternak tanpa injeksi hormon. Hasil kepadatan susu menunjukkan efek yang signifikan pada penurunan kepadatan susu kambing (28,81%) yang lebih rendah sebesar 10,65% dibandingkan yang tanpa injeksi hormon. Level bahan kering tanpa lemak (SNF), kandungan protein dan laktosa tidak berpengaruh dalam susu, yaitu 8,39%, 3,91% dan 3,76%, masing-masing. Kesimpulannya, injeksi hormon oksitosin memiliki efek yang sangat signifikan pada peningkatan kadar lemak susu dan secara signifikan mempengaruhi penurunan kepadatan susu tetapi tidak mempengaruhi level bahan kering tanpa lemak (SNF), laktosa dan protein.

Kata kunci: peranakan etawa, hormone oksitosin, injeksi, komposisi susu

Introduction

Goat is one of the ruminant livestock commodities widely cultivated in Indonesia. Besides being easy to breed, goats has a fast-growing population. Dairy goats as ruminasia livestock meet milk and meat demands (Dzarnisa et al., 2018).

Etawah crossbred goats are the result of a cross between Kacang goats (Indonesian local goats) and Etawah goats (Indian goats) (Budiarsana, 2009). The physical form resembles Etawah goats and they potentially produce animal protein such as meat and milk. PE goats weighing 32 - 37 kg can produce averagely 1 - 1.5 liters milk per day (Dzarnisa et al., 2019). Qualities such as high milk production, high growth rate and excellent adaptability to extreme environmental conditions has made goats being used to improve the genetic quality of local goats (Yunus, 2015).

Goat milk is one product with high nutritional content and may function as a natural remedy for certain types of diseases in human. The nutritional content of milk or milk composition is formed by the availability of

nutrients in the blood, while blood component is influenced by the nutritional intake of the food consumed. Forage-based feed may increase milk fat, while concentrate addition to feed can reduce milk fat level (Utami et al., 2014). In addition, hormonal influences in the body, especially oxytocin will affect the lactation process.

Oxytocin or also known as hypophamin (Assad et al., 2016) is a neurohipopial hormone secreted from meganocellular neurosecretion cells in the supraoptic and paraventricular nuclei of the hypothalamus which are stored in the posterior pituitary until released into the bloodstream. Oxytocin is formed from nine amino acids (Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-GlyNH_2) with a sulfur bridge between two amino acids cystine. The structure of oxytocin is similar to other nanopeptides, vasopressin (Avp) with 2 different amino acids compared to oxytocin. (Harjanto and Muhartono, 2015). Breastfeeding female animals are conditioned by visual and touch stimuli that are associated with milking to stimulate the release of oxytocin into the circulation. Oxytocin then reacts with cell myoepithelial (smooth muscle cells) that surround the alveoli of the mammary gland. The contraction of myoepithelial cells causes erosion of the alveoli, thereby pushing milk into the ducts of the mammary gland and causing milk to fall (Ismudiono et al., 2010).

Hormone induction from outside the body is an effort to improve milk composition apart from the application of feed technology and technology to manipulate the environment. In Indonesia, oxytocin hormone treatment for Etawah crossbred goats has not been conducted. This study aimed to investigate the extent of influence the level of milk composition is injected to Etawah crossbred goats.

Materials and Methods

This research was carried out on people's farms on the Syiah Kuala University, Syiah Kuala District, Banda Aceh, Indonesia, using 18 adult female Etawah crossbred. The study sample was taken randomly regardless of age, lactation, udder volume and weight.

The data were subjected to a normality test in the Saphiro-Wilk design before performing t test. If the data is not normally distributed, non-parametric tests are used with the Mann-Whitney design model. The study sample was divided into 2 groups, i.e. control group and oxytocin hormone treatment group. The measured parameters were fat content, non fat dry matter (SNF), lactose content, protein content and milk density.

This study used hormone injection with an intramuscular method because it is convenient compared to intravenous injections. Oxytocin hormone was injected 1 mL of 10 IU in the semimembranousus musculus. Previous study reported that injecting 10 IU could increase fat levels in merino sheep milk (Bencini, 1995). Hormone was injected 1 hour before morning milking which was performed using the whole hand technique.

The milk collected was directly put into sample bottles and milk composition was tested using a Lactoscan in the Laboratory of Dairy Production Science and Technology, Department of Animal Husbandry, Syiah Kuala University.

Results and Discussion

Milk is a livestock product that is used as a complementary food from the body's nutrients. The products of secretions from mammalian livestock glands of high nutritional value contain several main components such as fat, protein and lactose. One of the factors that influence milk composition is hormonal factors. Hormonal activity affects every cell that works in the body including secretory cells. The injection of the oxytocin hormone in Etawah crossbred goats is presented Table 1.

Fat Level

Based on the Mann-Whitney test, injecting oxytocin hormone in Etawah Crossbreds goats had a highly significant effect (P<0.01) on milk fat levels. The average milk fat level in control group and hormone treatment group was 5.05% and 4.86%, respective. It showed an increase in the group of goats injected with the hormone oxytocin. Milk fat levels were higher by 37.2% compared to the untreated group.

The process of forming milk fat starts from the cell. Fat is formed by a smooth endoplasmic reticulum that does not have ribosomes. The fat that has been formed from the riboosome is then taken to the golgi body as a place for transporting lipids (Sumitro et al., 2017). According to Suryowardojo (2012), fat globules are composed of triglyceride globules surrounded by a thin layer of membrane called the Fat Globule Membrane (FGM). FGM is composed of proteins and phospholipids. The role of FGM is as a stabilizer so that milk fat can emulsify with water in milk.

The percentage of milk fat varies between 2.4 - 5.5%. Milk fat is formed from one molecule of glycerol with three fatty acid molecules via an ester bond. Milk fat is composed of about 12.5% glycerol and 85.5% fatty acids (Laryska and Nurhajati, 2013). In milk, the fat content is influenced by the concentration of acetic acid in the rumen. Acetic acid is a precursor in the formation of fat in milk (Marwah et al., 2010). Comparison of percentage of fat content between hormone treatment groups and groups without hormone treatment is presented in Figure 1.

Table. 1. Average value of composition of goat's milk in etawah breeds during research

Treatment	Average test value of milk composition				
	Fat (%)	SNF (%)	Protein (%)	Lactose (%)	Density (%)
Control	3.05	8.79	4.13	3.94	31.88
Treatment	4.86	8.39	3.91	3.76	28.81

Description: Composition of milk during the study.

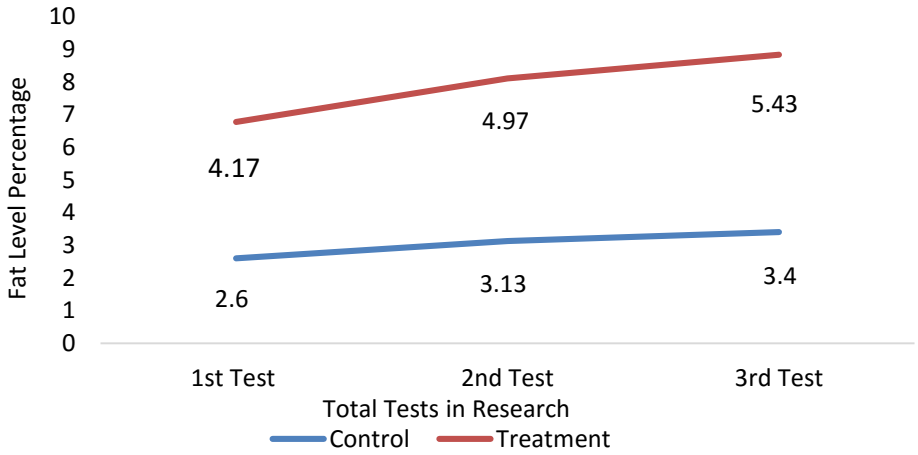

Figure 1. Milk fat percentage across treatments

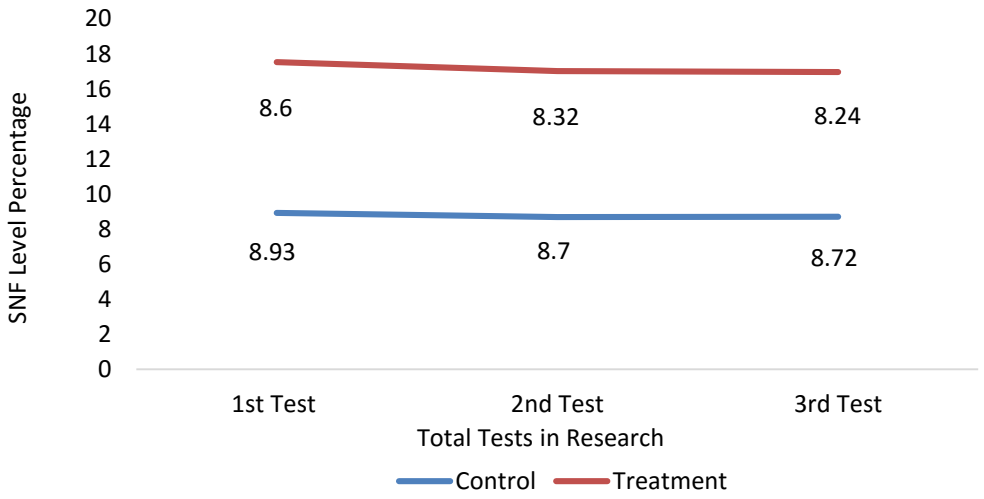

Figure 2. SNF percentage across treatments

Figure 1 shows that a persistent increase in fat levels during the study. The oxytocin hormone injection could maintain and increase the fat content of milk in Etawah Crossbreds goats. The difference in fat levels is caused by the increase in the number of fat globules in milk. Fat globule is added because hormone oxytocin stimulates myoepithelial cells to contract more strongly than usual so that the globule of fat that is still stored in the alveoli cells is also carried away during the occurrence of milk ejection.

Non Fat Dry Ingredients (SNF) Level

Statistical analysis showed that there was no effect (P>0.05) on SNF levels of Etawah Crossbreds goat milk injected with the hormone oxytocin. The chemical composition data showed that the average SNF level in control and hormone treatment group was 8.79% and 8.39%, respectively.

Non fat dry ingredients are milk fractions in addition to fat in the form of protein, carbohydrates, vitamins and minerals. Secretory cells are responsible for producing nutritional components in milk such as protein, fat, milk sugar, and minerals. The comparison of SNF percentage across treatments is shown in Figure 2.

Figure 2 shows that a slight decrease in SNF levels occurred in the treatment group. Adhani et al. (2012) mentioned three contributing factors to the increased SNF, namely decrease in milk fat, increase in milk dry matter and milk specific gravity. Therefore, SNF decrease in this study was caused by the increased levels of milk fat.

Protein Levels

The analysis of unpaired t test showed no effect on milk protein content of Etawah crossbred goat (P>0.05) injected with oxytocin hormone. The data showed that the average protein levels in control and treatment group was 4.13% and 3.91%, respectively.

The milk protein is produced from cells. In the endoplasmic reticulum, there are many ribosomes where proteins are formed (Sumitro et al., 2017). Suryowardojo (2012) also stated that protein is a component of milk formed in the mammary glands composed of alveolar collections.

Proteins are synthesized in ribosomes with mRNA bound to rRNA. tRNA will carry amino acids to the place of bond so that the molecules will increase. The anticodon from tRNA will place the amino acid in its original position. After the peptide bond is formed, the

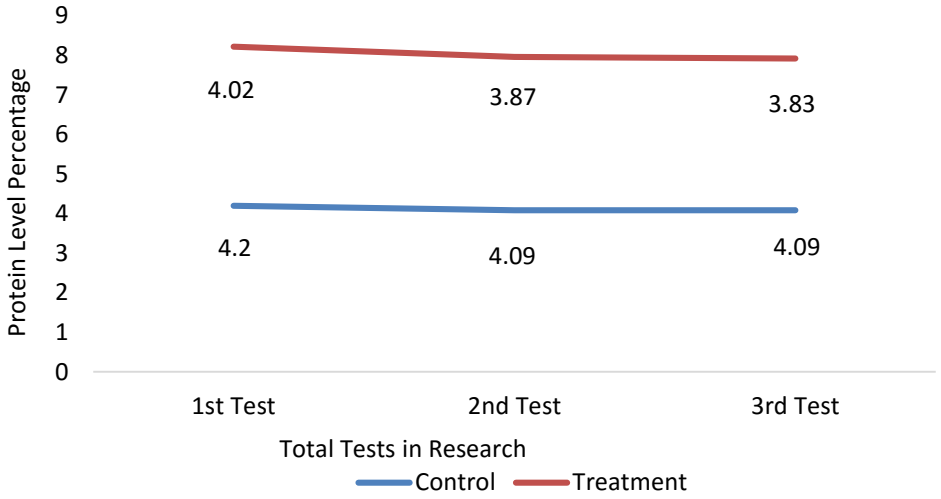

Figure 3. Milk protein percentage across treatments

tRNA is released into the cytoplasm to bind with other amino acids. Also, casein as a protein in milk decreases if production decreases. Laryska and Nurhajati (2013) stated that protein in milk is divided into casein and albumin. A comparison of the protein percentage across treatments is presented in Figure 3.

Figure 3 indicates that milk protein level did not in increase in both control and treatment groups. However, milk protein could decrease due to an increasing total fat globule. It was in line with Marwah et al. (2010) that milk protein level was correlated with milk fat levels – milk fat decreases if the concentration of milk protein increases.

Lactose levels

The results of the t test showed no effect (P> 0.05) on the lactose content of Etawah Crossbreds goat milk injected with hormone oxytocin. The average lactose content in control and treatment groups was 3.94% and 3.76%, respectively.

Lactose is milk sugar which is an important component in milk and is a nutritional component that can only be found in milk. Lactose is a type of disaccharide formed from 2 sugar monomers, i.e. glucose and galactose. Dzarnisa (2010) stated that lactose in milk is obtained from glucose in the blood. Also, Utari et al. (2012) explained that glucose which has been converted from protein after being absorbed from the intestine through the process of gluconeogenesis will increase glucose levels in the blood and could increase milk lactose because milk component is formed from blood components. Comparison of the percentage of lactose levels between hormone treatment and without hormone treatment is shown in Figure 4.

Based on Figure 4, hormone treatment shows that milk lactose levels tend to decrease during the study due to an increase in milk fat percentage (Zurriyati et al., 2011).

Milk Density

Oxytocin hormone had a significant effect (P<0.05) on milk density of Etawah crossbred goats based on unpaired t test analysis. The average milk density in control and treatment groups was 3.94% and 3.76%, respectively.

Milk density is influenced by milk weight and volume. The fat component and SNF influenced milk density. The effect of the hormone oxytocin makes milk density decrease which was negatively correlated with fat content. It was line with Ratya et al. (2017)

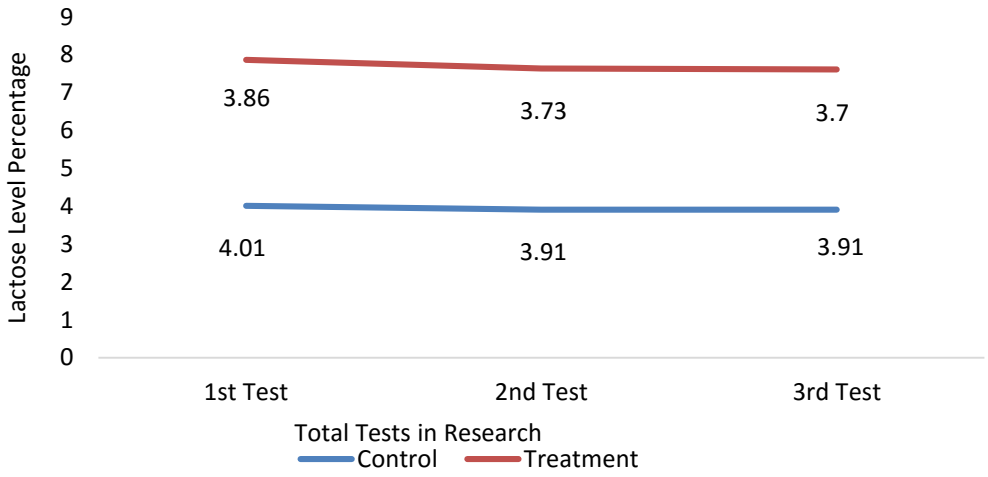

Figure 4. Lactose percentage across treatments

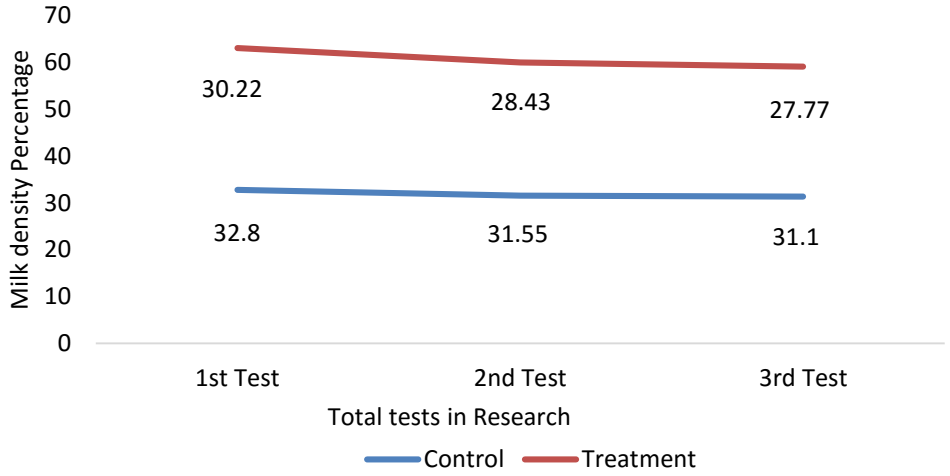

Figure 5. Milk density percentage across treatments

that fat content in milk negatively affected milk specific gravity. Also, Legowo in Ratya et al. (2017) reported that milk specific gravity depends on fat content and milk solids ingredients, because fat specific gravity is lower than the specific gravity of water or milk plasma. A comparison of the percentage levels of density between hormone treatment and without hormone treatment is shown in Fig. 5.

Figure 5 shows a decrease in milk density which was greater in treatment group than the control group. Hormone oxytocin increased the level of fat globules in milk, resulting in a decrease in milk density. Adhani et al. (2012) explained that milk specific gravity was influenced by the content of compounds in milk. Milk density has a positive relationship with milk SNF levels. The change in the percentage of one chemical fraction in milk composition would change the percentage of other milk composition fractions.

Conclusions

Etawah crossbred goats injected with oxytocin hormone showed an increase in milk fat levels and decreased milk density. This

study also concluded that Etawah crossbred goats injected with the hormone oxytocin did not showed an increase in protein levels, lactose levels, and levels of non fat dry ingredients

References

Adhani, D. A. C. N., T. Nurhajati and A. T. S. Estoepangestie. 2012. Potensi Pemberian Formula Pakan Konsentrat Komersil Terhadap Konsumsi dan Kadar Bahan Kering Tanpa Lemak Susu. Agroveteriner. 1(1):11-16.

Assad, N. I, A. K. Pandey, and L. M. Sharma. 2016. Oxytocin, Functions, Uses and Abuses: A Brief Review. Theriogenology Insight. 6(1):1-17.

Bencini, R. 1995. Use of Instramuscular Oxytocin Injections to Measure Milk Output in Nondairy Sheep, and Its Effect on Milk Composition. Australian Journal of Experimental Agriculture. 35:563-565.

Budiarsana, I. G. M. 2009. Analisis Ekonomi Usaha Ternak Kambing PE Sebagai Ternak Penghasil Susu dan Daging. Prosiding. Seminar Nasional Teknologi Peternakan dan Veteriner. Pusat Penelitian dan Pengembangan Peternakan, Badan Penelitian dan Pengembangan Pertanian, Kemetrian Pertanian. Bogor. 13-14 Agustus 2009. Pp: 411-418 (abstract in English).

Dzarnisa. 2010. Peningkatan Produksi Susu Periode Laktasi Berikutnya Melalui Kombinasi Injeksi Bovine Somatotropin (Bst) DAN Suplementasi Seng Selama Masa Kering Pada Sapi Peranakan Fries Holland (PFH). Disertations, IPB, Bogor. (abstract in English).

Dzarnisa, D. Rachmadi, A. Azhar, R. F. Riza and A. Hidayati. 2018. Milk Production, Physioogical Condition and Performance of Etawa Crossbreed Goats Feed by Ration Supplemented with Mangosteen Peel Flour. IOF Conf. Series: Earth and Environmental Science 119. International Ruminant Seminar: "Eco-friendly livestock production for sustainable agriculture". Faculty of Animal and Agrictural Sciences Diponegoro University. Semarang. 24 October 2017. Pp: 128-132.

Dzarnisa, C. I. Novita, Yurliasni, T. Handayani and S. Anggraini. 2019. Analisa Kualitas Kimia dan Mikrobiologi Susu Kambing Peranakan Etawa Dengan Pemberian Pakan Yang Ditambahkan Tepung Kulit Manggis Pada Persentase Yang Berbeda. Jurnal Ilmu dan Teknologi Hasil Ternak. 14(1):30-37.

Harjanto, A. R. and Muhartono. 2015. Korelasi Antara Pemakaian Oksitosin Drip pada Ibu dengan Angka Kejadian Hiperbilirubinemia Neonatal. Journal Agromed Unila. 2(3):278-283.

Ismudiono, P. Srianto, H. Anwar, S. P. Madyawati, A. Samik and E. Safitri. 2010. Buku Ajar Fisiologi Reproduksi Pada Ternak. Departemen Reproduksi Veteriner Fakultas Kedokteran Hewan, Universitas Airlangga. Airlangga University Press. Surabaya.

Laryska, N. and Nurhajati, T. 2013. Peningkatan Kadar Lemak Susu Sapi Perah Dengan Injeksi Pakan Konsentrat Komersil Dibandingkan Dengan Ampas Tahu. Agroveteriner. 1(2):79-87.

Marwah, M. P. Suranindyah, Y. Y. and Murti, T. W. 2010. Produksi dan Komposisi Susu Kambing Peranakan Ettawa yang Diberi Suplemen Daun Katu (*Sauropus androgynus (L.) Merr*) Pada Awal Masa Laktasi. Buletin Peternakan. 34(2):94-102.

Ratya, N., E. Taufik and I. I. Arief. 2017. Karakteristik Kimia, Fisik dan Mikrobiologis Susu Kambing Peranakan Etawah di Bogor. Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan. 5(1):1-4.

Sumitro, S. B., S. Widyarti and S. Permana. 2017. Biologi Sel (Sebuah Perspektif Memahami Sistem Kehidupan). UB Press. Malang. Pages: 193.

Suryowardojo, P. 2012. Penampilan Kandungan Protein dan Kadar Lemak Susu Pada Sapi Perah Mastitis Friesian Holstein. The Journal of Experimental Life Science. 2(1):42-48.

Utami, K. U., L. E. Radiati and P. Surjowardojo. 2014. Kajian Kualitas Susu Sapi Perah PFH (Studi Kasus Pada Anggota Koperasi Agro Niaga di Kecamatan Jabung Kabupaten Malang). Jurnal Ilmu-Ilmu Peternakan. 24(2):58-66.

Utari, F. D., B. W. H. E. Prasetiyono and A. Muktiani. 2012. Milk Quality of Ettawa Crossbreed Goat Fed on Supplementation of Protected Protein in Complete Feed Wafer Base on Agroindustrial By-product. Animal Agriculture Journal. 1(1):427-441.

Yunus, A. 2015. Potensi Besar Beternak Kambing Boerka. Bibit Unggul Baru Kualitas Ekspor. Pustaka Baru Press. Yoyakarta.

Zurriyati, Y., R. R. Noor and R. R. A. Maheswari. 2011. Analisis Molekul Genotipe Kappa Kasein (K-Kasein) dan Komposisi Susu Kambing Peranakan Etawah, Saanen dan Persilangannya. Jurnal Ilmu Ternak Veteriner. 16(1):61-70.