Milk production and chemical composition of crossbred Friesian Holstein fed diet containing protected soybean groats as feed supplement

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Abstract. Sufficient nutrient availability in the early period of lactation is needed to improve and to optimize milk production and composition of dairy cows. The objective of this study was to evaluate milk production and chemical composition of crossbred Friesian Holstein fed by diet containing protected soybean groats as feed supplement. Soybean groat was protected by 1% formaldehyde. It was supplemented to three groups of treatment consisted of basal diet (P1), basal diet supplemented by 2% protected soybean groat (P2), and basal diet supplemented with 4% protected soybean groats (P3). A total of 15 lactating dairy cows (crossbred Friesian Holstein) were used in this study. They were equally grouped into three different treatments. Milk samples were measured using milk scan and they were statistically analyzed using the R programing. Duncan’s multiple range test (DMRT) was also applied to distinguish among treatments. The results showed that supplementation of protected soybean groats significantly affected fat and protein contents. Cows treated by diet supplemented with 4% protected soybean groat was found containing highest milk fat percentage. In addition, protected soybean groat supplementation in the diet statistically increased milk proteins. Lactose in the milk was not affected by treatment. In conclusion, supplementation of protected soybean groat in the crossbred Friesian Holstein diet improved milk chemical quality.

1. Introduction
Crossbred Friesian Holstein dairy cows need sufficient nutrients for their daily needs, especially at the beginning of the lactation period (first trimester). Dairy cow generally faces insufficient nutrient needs in this period due to poor feed intake which is not able to support the required energy for milk yield. This condition is well known as negative energy balance [1]. Negative energy balance can reduce milk production and fertility in dairy cows [2]. Adequacy of protein and energy in the diet is the most important thing to increase milk production and quality. Protein in the diet should be protected to avoid microbial degradation in the rumen, therefore protein can survive through ruminants (by pass) and can be directly utilized [1]. The increase of crude protein levels in the ration is expected to be followed by an increase of nutrient digestibility and milk production [3].

Soybean groat which is widely known as protein sources is a potential feedstuff due to its high amino acid content. Protected soybean groat is needed to optimize by passed protein in the small intestine. Therefore, it can be used by dairy cows for milk synthesis. Previous study reported that
protected protein source in the diet increase protein in the small intestine needed for milk synthesis, especially to increase fat and milk protein contents [4]. Based on statements above, this study evaluated milk production and chemical composition of crossbred Friesian Holstein fed by diet containing protected soybean groats as feed supplement.

2. Material and methods

2.1. Sample preparation
This research was used 15 crossbred Friesian Holstein dairy cows with average weight ±450 kg. Soybean groats were protected using 1% formaldehyde calculated from dry matter (DM) of soybean groats. Three groups of treatment consisted of basal diet (P1), basal diet supplemented by 2% protected soybean groat (P2), and basal diet supplemented with 4% protected soybean groats (P3). Each treatment was repeated five times.

| Item                        | P0    | P1    | P2    |
|-----------------------------|-------|-------|-------|
| Feedstuff composition, %    |       |       |       |
| King grass                  | 27.73 | 27.73 | 27.73 |
| Basal concentrate           | 46.23 | 46.23 | 46.23 |
| Soya cake waste             | 26.03 | 26.03 | 26.03 |
| Protected soybean groats    | 0     | 2     | 4     |
| Total amount                | 100   | 102   | 104   |
| Nutrients content, %        |       |       |       |
| Crude protein               | 10.52 | 11.08 | 11.65 |
| Extract ether               | 3.86  | 4.25  | 4.66  |
| Crude fibre                 | 23.21 | 23.35 | 23.49 |
| Organic matter              | 88.84 | 90.97 | 93.12 |
| Ash                         | 10.23 | 10.39 | 10.56 |
| Total digestible nutrient   | 64.55 | 65.21 | 65.76 |

2.2. Measurement fat and protein
Fat, and protein content were measured using milk analyzer Milk scan MCC50 in the laboratory.

2.3. Data analysis
Data collected in this study was analyzed by analysis of variance (ANOVA) by custom script written in the R programing. The Duncan’s Multiple Range Test (DMRT) was carried out to differentiate among treatments [5].

3. Results and discussion
Effect of feed supplement in milk production and chemical composition are presented in table 1. Protected soybean groats supplementation in the diet at 4% levels improved milk production (P<0.05). The increase of milk production might be associated to the supplementation of protected soybean groats improving protein and energy density by pass of the diet. It implied to improvement of milk quality and milk production. Production of milk in dairy cow can be improved with the diet supplemented by protein and energy density [1,6]. In addition, the results in this present work were in line with previous studies reported that feed supplemented by protein and energy density increased dairy cow milk production [6,7].

The study showed that protected soybean groats at 2% and 4% levels in the diet could increase milk protein (P<0.05). This might be caused by the protected protein in the ration is not completely digested in the rumen, so that some protein can be by passed into the intestine and digested into amino
acids. The increase of amino acids availability in the intestine could be absorbed by the intestine and then flowed through the blood to the udder secretory cells and then synthesized into milk protein [7].

Table 2. Milk protein, fat and lactose contents of dairy cows.

| Variables            | P0    | P1    | P2    |
|----------------------|-------|-------|-------|
| Milk production (Kg) | 10.33a| 11.18ab| 12.41b|
| Milk protein (%)     | 2.74c | 2.86d | 2.88d |
| Milk fat (%)         | 2.88e | 3.18f | 3.60g |
| Milk lactose*        | 3.98  | 4.06  | 4.18  |

P1: basal diet; P2: basal diet supplemented by 2% protected soybean groat and P3: basal diet supplemented with 4% protected soybean groats. abcdDifferent superscript in the same row indicates significant difference (p<0.05); dfDifferent superscript in the same row indicates highly significant difference (P<0.01).

Supplementation of protected soybean groats at 2% and 4% levels also increased fat content of milk (p<0.01). It might be due to diet containing protected fatty acids could be transferred into system of milk fat synthesis directly. Long-chain fatty acid ration balance transfer affects milk fat through milk fat synthesis in the mammary gland [1]. Moreover, previous study proved that protected fat supplementation also improved the content of fat in the milk. On the other hand, reduction of milk fat content was found in the dairy cow given feed containing fish oil and canola oil [9].

No differences in the lactose content among treatments was found in this study. It might be due to fat contained in the diet used as source of energy mostly for milk production, fat and protein synthesis. In lactating dairy cows, glycerol is used as substrate for glucose synthesis through glucogenesis. It is generally utilized for energy sources rather than precursor for synthesis of lactose in the mammary gland [10].

4. Conclusion
Soybean groats supplementation in the diet can improved milk production and milk quality of crossbred Friesian Holstein.

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References
[1] Pramono A, Handayanta E, Triwidayati D, Putro P P and Kustono 2017 Dietary protected feed supplement to increase milk production and quality of dairy cows IOP Conference Series: Materials Science and Engineering 193 012034
[2] Esposito G, Irons P C, Webb E C and Chapwanya A 2014 Interactions between negative energy balance, metabolic diseases, uterine health and immune response in transition dairy cows J. Anim. Reprod. 4874: 1–12
[3] Amanlou H, Farahani T A and Farsuni N E 2017 Effect of rumen degradable protein supplementation on productive performance and indicators of protein and energy metabolism in Holstein fresh cow J. Dairy Sci. 100 (5): 1–13
[4] Widyobroto B P, Budhi S P S and Agus A 2010 Effect of protein undegraded supplementation on production and composition of milk in dairy cows J. Indon. Tropic. Anim. Agric. 35 27–33
[5] Steel R G D and Torrie J H 1991 Principle and Procedure of Statistics 2nd ed (Newzealand: McGraw-hill Book Company Auckland)
[6] Brito A F and Broderic G A 2007 Effects of different protein supplements on milk production and nutrient utilization in lactating dairy cows J. Dairy Sci. 90 1816–27
[7] Widyobroto B P 1992 Pengaruh aras konsentrat dalam ransum terhadap kecernaan dan sintesis N mikrobia dalam rumen pada sapi perah Buletin Peternakan edisi khusus (Yogyakarta: Fakultas Peternakan Universitas Gadjah Mada)

[8] Leonardi C S, Bertics and Armentano L E 2005 Effect of increasing oil from distillers grains or corn oil on lactation performance J. Dairy Sci. 88 2820–7

[9] Santos J E P, Bilby T R, Thatcher W W, Staples C R and Silvester F T 2008 Long chain fatty acids of diet as factors influencing reproduction in cattle Reprod. Domest. Anim. 43 23–30

[10] Hames, D and Hooper N 2005 Bios Instan Notes. Biochemistry 3rd ed (New York: Taylor and Francis Group)