The effect of protected soybean groats and lemuru fish oil supplementation in ration on performance of Ongole crossbred cows

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Abstract. This study aims to determine the effect of protected soybean groats and lemuru fish oil as feed supplement on the performance of Ongole crossbred cows at postpartum periods. The treatments were P1 = 90% basal feed + 10% unprotected soybean groats and lemuru fish oil mixture; P2 = 90% basal feed + 5% unprotected soybean groats and lemuru fish oil mixture + 5% protected soybean groats and lemuru fish oil mixture; P3 = 90% basal feed + 10% protected soybean groats and lemuru fish oil mixture. Birth weight of calves at P1, P2, and P3 treatments were 26.00, 31.60, and 28.40 kg, respectively. The results of the variance analysis showed that the use of soybean groats protected lemuru fish oil in rations significantly affected the daily weight gain of calves but did not affect the daily weight gain of cows as well as feed conversion and efficiency. The conclusion of this study was that the use of 5% protected soybean groats and lemuru fish oil mixture combined with 5% unprotected soybean groats protection and lemuru fish oil mixture in ration of Ongole crossbred cow able to increased birth weight and average daily gain of calves.

1. Introduction
The Ongole crossbred cow in Indonesia is mostly kept in the rural livestock business system. The Ongole crossbred cow is very potential as calf producers. But on the other hand, the level of productivity is still not optimal, especially reproductive performance which is still low during pre-parturition and postpartum. One effort to increase the productivity of the Ongole crossbred cow can be by providing nutrient intake through the use of protein from soybean groats and lemuru fish oil.

Soybeans groats are obtained from the peeling process of soybeans from their pods in the form of soybean fractions containing more than 35% protein [1]. Lemuru fish oil (Sardinella longiceps) is a
waste produced by lemuru fish processing [2]. Proteins during the digestive process in the rumen are
degraded by rumen microbes. For this reason, protection is needed so that protein can escape
microbial degradation until it can be absorbed in the small intestine. Protein protection in feed
ingredients can use aldehydes from formaldehyde for cereal flour protection [3], soybean flour [1], and
soy flour and linseed [4]. This method of fat protection is done through the use of protein feed
ingredients matrix for cross-linking with aldehydes from formaldehyde. The feed protein will be
trapped in an insoluble matrix in the form of cross-linking protein molecules with formaldehyde but
not undergoing chemical changes [5].

Soybean meal protected with 1% formaldehyde in water ratio of 1:10 (weight/volume) consisted of
formaldehyde in the water around 80 ppm [6]. Formaldehyde content in animal feed which is less than
680 ppm in the digestive tract of livestock are absorbed and metabolized to CO₂ and eliminated
through the digestive tract [7]. Formaldehyde can be used as a nutritional protection material for feed
ingredients such as proteins and fatty acids so that it is not degraded and hydrogenated by rumen
microbes [8]. Feeds containing whole roast, linseed, and protected palm oil supplements can be given
to postpartum cows from delivery to 40 days [4].

Nutrients improvement in livestock rations can be conducted with the addition of soybeans and fish
oil. Soybean groats have protein content above 35% but its properties are rapidly degraded in the
rumen so that protection using formaldehyde can avoid excessive degradation in the rumen [1].
Aldehydes from formaldehyde will form strong cross bonds that can limit rumen microbes to degrade
proteins. Lemuru fish oil is the by-product of canning lemuru can be used as a source of fatty acids
that function as an energy source [5]. Lemuru fish oil is the by-product of canning lemuru can be used
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The increase in the percentage of formaldehyde linearly increases the total absorption of essential
amino acids and bioavailability of protein soybean meal feed [9]. Studies related to the results of
research on soybean meal protection mixture and lemuru fish oil using formaldehyde in the ration of
the beef cattle have not been found in Indonesia. Research has been conducted on the use of lemuru
fish oil and protected palm oil in male local sheep [10]. This research is important to produce the main
source of soybean-based beef ration and formaldehyde protected lemuru fish oil as additional feed to
increase the production and reproduction of beef cattle.

2. Materials and methods

This research was conducted at the Indonesian Beef Cattle Research Station, Indonesian Ministry of
Agriculture in Grati, Pasuruan, East Java. Fifteen Ongole crossbred cows with an average initial body
weight of 332.83 ± 48.35 kg and BCS 2.5 (1-5) were used in this study. Ongole crossbred cows used
in this study were 2-2.5 years old and had one calf. Called ongole crossbred cows because these cows
are the offspring of a breed between Zebu Cattle cows and Java cows through ongolization or grading
up programs in Indonesia. Ongole crossbred cows are indigenous cows that have adapted to the
Indonesian environment. This ongole crossbred cow has a grayish white color and fur around black
eyes. Research feed was given for 100 days including 30 days before birth (prepartum periode) and 70
days after birth (postpartum periode). Calves are weighed after birth. The average daily gain of calves
and cows are known to weigh every two weeks during the postpartum period research.

The cows were caged in individual cages equipped with an exercise yard, a place to feed and drink.
The ration used in this study consisted of elephant grass, rice straw, the basal concentrate of
Indonesian Beef Cattle Research Station. The feed composition of the research ration is:
Table 1. Feed formulation of research rations

| Feed Material                  | Treatment (%) |       |       |       |
|-------------------------------|---------------|-------|-------|-------|
|                               | P1            | P2    | P3    |       |
| Rice straw                    | 26            | 26    | 26    |       |
| Elephant grass                | 12            | 12    | 12    |       |
| Basal ration                  | 52            | 52    | 52    |       |
| Soybean groats and lemuru fish oil without protection | 10 | 5 | 0 |       |
| Protected soybean groats and lemuru fish oil | 0 | 5 | 10 |       |
| Total                         | 100           | 100   | 100   |       |

P1 = 90% basal feed + 10% unprotected soybean groats and lemuru fish oil mixture; P2 = 90% basal feed + 5% unprotected soybean groats and lemuru fish oil mixture + 5% protected soybean groats and lemuru fish oil mixture; P3 = 90% basal feed + 10% protected soybean groats and lemuru fish oil mixture.

This study used a completely randomized design (CRD) design with 3 treatments and 3 replications with each replication consisted of 1 Ongole crossbred cow. The protection of formaldehyde is done by sun drying the soybeans, pounded into soybean groats flour, and then sprayed with 37% formaldehyde solution as much as 1% of soybeans (dry matter). Then it is pressed for at least 1 hour to reduce the formaldehyde odor. After that lemuru fish oil was added in a ratio of soybean groats:fish oil at 1:4 and then homogenized. The research variables included daily weight gain, calves birth weight, and calves weight gain, as well as feed conversion and efficiency. Feed conversion ratio data is calculated by comparing the consumption of feed in dry matter and the resulting average daily gain, while the FER is determined by comparing the weight gain obtained from consuming feed in dry matter. Research data obtained after tabulation was continued with data analysis using analysis of variance with probabilities of 0.01 and 0.05.

3. Results and discussion

The results of daily weight gain, conversion and feed efficiency, birth weight, and daily calves weight gain are presented in Table 2.

Table 2. Daily weight gain, conversion and feed efficiency, calves birth weight, and calves weight gain

| Variables                     | Treatment          |       |       |       |
|-------------------------------|--------------------|-------|-------|-------|
|                               | P1                 | P2    | P3    | Significance |
| Cow average daily gain (kg/day)| -0.22±0.51         | -0.08±0.23 | -0.28±0.09 | ns |
| Cow feed conversion           | -16.15±0.29        | -13.74±2.33 | -43.67±1.15 | ns |
| Cow feed efficiency           | -0.022±0.05        | -0.007±0.02 | -0.025±0.08 | ns |
| Calves birth weight (kg)      | 24.00±3.46         | 32.00±5.30 | 26.67±1.53 | * |
| Calves average daily gain (kg/day)| 0.47±0.20         | 0.70±0.06 | 0.62±0.09 | * |

P1 = 90% basal feed + 10% unprotected soybean groats and lemuru fish oil mixture; P2 = 90% basal feed + 5% unprotected soybean groats and lemuru fish oil mixture + 5% protected soybean groats and lemuru fish oil mixture; P3 = 90% basal feed + 10% protected soybean groats and lemuru fish oil mixture. a,b Means with different superscripts are differ at P<0.05.

The use of protected soybean meal and lemuru fish oil in postpartum Ongole crossbred cow rations did not affect the average daily gain of cows. The percentage decrease in average daily gain in this study was P1 = 7.58%, P2 = 4.34%, and P3 = 5.74%. It was reported that the decrease in postpartum Ongole crossbred cow average daily gain was in the range of 2.6% [11] or around -0.077 ± 0.5 kg/day.
Ongole crossbred cow postpartum not only use their energy for their daily lives but are also used to produce milk for calves. If the energy used for milk production is less then it will take energy from energy deposits in the body so that it will experience a decrease in body weight or commonly called negative energy balance. The consequence is a decrease in body weight and fat reserves. Poor nutritional status decreases reproductive appearance which is characterized by a decrease in body condition and disruption, even cessation of reproductive processes [13]. Energy requirements in postpartum cattle are mostly obtained from body fat tissue. Body fat tissue is oxidized because energy consumption from the feed will not meet the needs so that a negative energy balance occurs [14].

The average of P2 calves birth weight was higher compared to P1 and P3 calves. The calves birth weight is greater than previous studies [15, 16]. This differences in values indicate that higher birth weight is related to higher nutrients consumption of cows. Birth weight is also influenced by maternal factors [17]. Birth weight is influenced by calf sex, age of the mother, and birth period [18]. Calf birth weight will affect its growth in the future. Calf birth weight can affect body weight gain and adult weight. Birth weight as a selection criterion is associated with optimal birth weight which has a positive correlation with the growth potential of cattle in the next period [19]. Young cattle that have a high birth weight tend to have high growth acceleration abilities and can reach adult weights at a younger age.

The average daily gain of calves in P2 was higher than P1 and P3. Calves daily weight gain is influenced by milk produced by the parent because it has not been influenced by other feeds. Feed mixtures of unprotected soybean meal and lemuru fish oil and protected soybean meal and lemuru fish oil of 5% (P2) can be optimized by cows to produce better quality milk than other treatments. Ongole crossbred calves daily body weight gains were ranged at 0.32 to 0.42 kg [20]. This showed that the calves’ daily weight gain of Ongole crossbred that was given a supplement of soybean meal supplement and lemuru fish oil experienced a very good increase. The feed given is very good for increasing weight gain and daily Ongole crossbred calves. The birth weight of calves whose were treated P2 had the highest average body weight so that the daily weight gain also showed high results. Calves with high birth weights will have the fastest growth.

Use of protected soybean meal and lemuru fish oil in rations postpartum Ongole crossbred did not affect feed efficiency. Feed efficiency values are closely related to feed conversion values. Feed efficiency in beef cattle is between 7.52 to 11.29% [21]. Factors that influence the value of feed efficiency are gender, livestock condition, age of livestock, feed quality, and animal body weight.

4. Conclusions
The conclusion of this study was that the use of 5% protected soybean groats and lemuru fish oil mixture combined with 5% unprotected soybean groats protection and lemuru fish oil mixture in ration of Ongole cross bred cow able to increased birth weight and average daily gain of calves

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References
[1] Riyanto J, E Baliarti, T Hartatik, D T Widayati and L M Yusiati 2014 Proceedings of the 16th AAAP (Yogyakarta: Faculty of Animal Science, Universitas Gadjah Mada)
[2] Yusiti L M, Z Bachrudin, C Hanim and E Lestari 2008 Proceedings International Seminar The Management Strategies of Animal Health and Production Control in the Anticipation of Global Warming for the Achievement of Millenium Development Goal. (Surabaya: Faculty of Veterinary Medicine Airlangga University)

[3] Mohammadian-Tabrizi H R, H Sadeghipanah, M Chamani, Y Ebrahim-Nejad and H Fazaeli 2011 African J. Biotech. 10 7710–7716

[4] Dirande, E, A Towhidi, S Zeinoaldini, M Ganjkhanlou, Z A Pirrsaei 2013 J. Anim. Sci. 91 713–721 (Abstr.).

[5] Jenkins T C, R J Wallace, P J Motae and E E Mosly 2008 J. Anim. Sci. 86 397-412

[6] Suhartanto B, R Utomo, Kustantinah, I G S Budisatria and L M Yusisti 2014 Buletin Peternakan 38 141–149

[7] Riyanto J and Sudibya 2018 IOP Conf. Ser.: Earth Environ. Sci. 119 012020

[8] Emanuele, S M and D Putnam 2006 proceedings Ruminant nutrition symposium (Gainesville FL :Florida Best Western Gateway Grand)

[9] Akif M Y R K, T Aksu, M Gul and D Bolat 2006 Turk. J. Vet. Anim. Sci. 30 457–463

[10] Wibowo M S 2012 Effect of lemuru fish oil supplementation and protected palm oil in the ration on the performance of local male sheep Thesis (Surakarta: Universitas Sebelas Maret)

[11] Affandhy L, Rasyid, and A Khrisna 2010 Proceedings of the National Seminar on Animal Husbandry and Veterinary Technology 2010 40–46

[12] Sariubang M, A Nurhayu and A Saenab 20010 Proceedings of the National Seminar on Animal Husbandry and Veterinary Technology 2010 60-65

[13] Pradhana R and Nakagoshi N 2008 Journal of International Cooperation and Development 14 45–66

[14] Remppis S, Steingass H, Gruber L and Schenkel H 2011 AsianAust. J. Anim. Sci. 24 540–572

[15] Rasyid A, Affandhy L, Pratiwi W C 2009 Proceedings of the National Seminar on Animal Husbandry and Veterinary Technology 35–40

[16] Aryogi, Prihandini, P W and Wijono D B 2006 The Pattern of Ongole Breeding Local Beef Cattle in the Livestock Farm Conditions (Pasuruan: Beef Cattle Research Station)

[17] Dodenhoff J, Vleck L D V, Kachman S D, Koch R M 1998 J Anim Sci. 76 2521–7

[18] Djagra I B F, Lana and Sulandra 1979 Proc Expertise Seminar in Animal Husbandry (Denpasar: Faculty of Veterinary Medicine Universitas Udayana)

[19] Oluwumi S O and Saloko A E 2010 Global Veterinaria 5 255–258

[20] Putu I G, P Situmorang, A Lubis, M Winugroho, and T D Chanlago 1999 Calf Maintenance Strategies in Order to Improve Production and Reproductive Performance (Bogor: Animal Research Institute)

[21] Siregar S B 2001 Ruminants-Livestock ration (Jakarta: Penebar Swadaya)

[22] Soebiarinoto, S Chuzamaeni, and Mashudi 1991 Ruminant Nutrition (Malang: Brawijaya University)