Performance of Ongole Crossbred beef cattle with application of fermented Total Mixed Ratio (TMR) derived from soybean waste

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Abstract. The objective of the study was to identify performances of the "Ongole" Crossbred pregnant cows fed with fermented total mixed ratio (TMR). This study was conducted at colony cages in Boloh Village, Toroh sub-districts, Grobogan District, Central Java. It was conducted for 7 months starting from 1st March to 30th September 2018. In this experiment, there were 12 pregnant cows with an initial body weight of 308,71±47 kg with the age of 3-4 years. The TMR consisted of soybean forages and the concentrate is fed to six pregnant cows as much as 2.5% of body weight and the others were used as a control with non-fermented TMR. Data observed include gas production, pH and feed in vitro digestibilities. Several parameters that were collected consisted of body condition score (BCS), mating interval and S/C. The data were analyzed using independent of t-test statistics. The results showed that based on the feed digestibility, fermented TMR had good digestibility and less gas production that was expressed by 48 hours incubation in-vitro trial.

1. Introduction

Agricultural waste of soybean straw is available abundantly in center areas of soybean farming, especially during the harvest season. The management of soybean waste utilization has not been performed and occasionally it is only burned or just thrown away and piled up into garbage that disturbs the scenery. Besides, it takes a relatively long time for soybean straw to be decomposed naturally in the soil. To improve the quality of soybean straw as feed materials, it is suggested to mix it with soybean agroindustry by-products such as tofu and soy sauce, then fermented into total mixed ration (TMR).

The total area of soybean production in Central Java was 65,278 hectares in 2013 [1]. It indicates that soybean cultivation within 1 hectare can produce 1.75 tons of soybean straw. Based on this calculation, the production of waste is approximately 113.75 tons in dry weight and it is equivalent to the ability to feed 18,200 of livestock unit of ruminants, in which a livestock unit requires dry matter as much as 6.25 kg/day [2].

At present, the benefits of feeding cattle with TMR have been widely accepted. The advantages of TMR includes increasing feed consumption, cheap alternative for feed ingredients, ability to control the ratio of forage concentrates, reducing the frequency of metabolic and digestive disorders, and lowering the labor input for feeding [3].

Fermentation of agricultural waste is an effort to improve the quality of animal feed ingredients. Biochemically, the fermentation process is the formation of energy through organic compounds, while the application in the fermentation industry is defined as a process of converting basic materials into processed products by microbial cells mass.

The activities of tofu, soy sauce and biomass agro-industry derived from agricultural waste and estate by-products used as livestock feed are often regarded as waste. The development of integrated ruminant agribusiness in the integrated production system is measured with a pattern of agriculture and estate within an area (crop-livestock system). The application of waste through recycling the environmental biomass by fermentation method is known as "zero waste production system" [4].

2. Material and methods

The study employed 12 pregnant cows at the age of 8 months with an average body weight 302.71 ± 47 kg. Feeding with fermented TMR of 2% of the bodyweight was applied to 6 pregnant cows, while the other 6 pregnant cows were given non-fermented TMR as a control. The BCS measurement used a score of 2 - 6 (2 = very thin; 3 = thin; 4 = borderline; 5 = moderate; 6 = fat) [5]. The parameters measured involve BCS of a pregnant cow, calf birth weight, service per conception (S/C), and mating interval after calving.

This feed formula contains crude protein 17.19% and TDN 59.62% as needed by pregnant cows, which is already more than its need (Table 1.). In vitro digestion, gas production and pH of TMR feed and FTMR with incubation times for 6 hours, 12 hours, 24 hours & 48 hours according to Goering & Van Soest method [6].

Table 1. Composition of the fermented total mixed ratio

Ingredients	**Percentage (%)**
Concentrate:	
Rice brand	6,63
Molasses (drop)	2,39
Mineral	0,40
Salt	0,41
Tofu waste	11,06
soy sauce waste	10,24
Bacteria Starter (Biofad)	0,20
Forage:	
Corn stover	32,06
Soybean waste	36,63
Total	**100,00**
Nutrient content *:	
Water content	43,28
Crude Protein	17,19
Crude fiber	17,88
Crude fat	1,06
Ash	14,30
Total Digestible Nutrient	59,62

*) Result of analysis at the Feed and Nutrition laboratory, Faculty of Animal Science and Agriculture, University of Diponegoro, Semarang

3. Results and discussion

Data of pH, total gas production (ml) and digestibility percent were collected from in vitro digestion experiments for 6 hours, 12 hours, 24 hours & 48 hours of the incubation period. Average total gas

production at 6 hours, 12 hours, 24 hours, and 48 hours in TMR feed were 27.7 ml, 36.8 ml, 54.6 ml, 73.5 ml respectively and that of FTMR feed were 17.4 ml, 28, 8ml, 45.2ml, and 59 ml respectively. FTMR feed significantly produce less gas production than TMR feed ($p < 0.01$).

The pH value tends to decrease by the increase of incubation period in which there were no significance differences indicated by the average pH value of TMR & FTMR at 6 hours was 6.29 and 6.60 and that of 48 hours was 5.69 and 5.64, respectively. At each hour of the incubation period, the percentage of digestibility was significantly higher in FTMR feed than TMR ($p < 0.01$). The average digestibility of TMR & FTMR at 24 hours was 33.54% and 43.14% and at 48 hours was 35.70%, and 45.11%, respectively. The fermented TMR has good digestibility and less gas production expressed by the 48-hour in vitro trial (Figure 1).

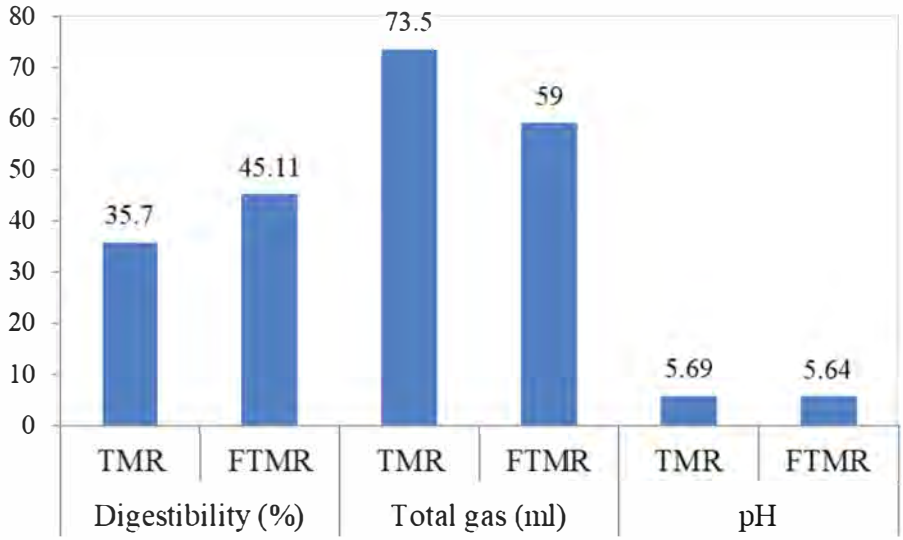

Figure 1. Digestibility%, Total gas (ml), pH value at 48hr In-vitro trial

Feed digestibility is influenced directly by ingesta, feed composition, feed processing, protein to energy ratio, degradation rate and internal factors in livestock [7]. Based on the pregnant cow parent data, though the statistical analysis showed no influence, it reflected that feed treatment of total mixed ratio fermentation has a good influence to the calf birth weight with an average of 28.44 kg, higher than the control that is 25.22 kg. The BCS of pregnant cows was 4.2, better than controls, that was 3.3 and statistically it showed no influence. The interval of mating after the calving of pregnant cows was shorter that was 45.5 days compared to controls, 58.5 days. It significantly influenced ($P < 0.05$) and showed a lower service per conception (S/C) that was 1.5 compared control, that was 3.

The nutritional status or livestock balance are evaluated through BCS, reflecting available body reserves for basic metabolism, growth, lactation, and activity [8]. Body fat is an indication of stored energy. To maintain health, reproductive function, and productive capacity, female cattle must have adequate amounts of nutrient reserves in the body [9].

Table 2. The total mixed ratio effects on reproductive performance of pregnancy cows

Variable	Treatment		P-value
	TMR	FTMR	
Body weight of cow (kg)	308,17±21,36	353,17±81,04	0,218
Birth BW (kg)	25,22±2,93	28,44±4,26	0,159
Body Condition Scores	3,3±0,82	4,2±0,75	0,096
Days to firt service	58,5±8,11	45,5±8,57	0,022
Service per conception	3±1,67	1,5±0,54	0,063

The main factors that influence the duration of postpartum anesthesia in cattle are nutritional status (measured by BCS) and breastfeeding [5]. Several other factors such as breed, age, number of births, milk production, delivery season, delay in uterine involution, dystocias and general health status affect the duration of postpartum anesthesia [10]. Nevertheless, [11] states that each factor is considered as a possible cause of postpartum anestrus, in addition to nutrition and calf birth.

In Bos indicus, cows that give birth with better BCS, and maintenance after delivery, have better reproductive performance than cows that give birth with poor BCS conditions [10]. It is because a better pituitary function is a result of better reproductive potential, which translates into an early return to postpartum estrus [12].

Poor nutrition and low BCS are important factors that reduce fertility in tropical cows [13]. The results showed that cows with BCS> 2.75 (on a scale of 1-5) had a greater pregnancy rate than cows with BCS <2.5 (Nishimura *et al.*, 2018). This result is consistent with the positive relationship between BCS and pregnancy rate described in beef cattle. Furthermore, cattle that lost BCS after calving and before pregnancy were diagnosed to have a lower pregnancy rate when compared to cattle that maintained or increased BCS [14–15].

Although feeding using agricultural waste each season is assumed to provide a low quality, however according to analysis results, it still meets the needs of pregnant cows. The reproductive activity of cows requires a crude protein content of 7% [16].

The calf birth weight from the parent that received FTMR compared to TMR cow was 26.85 and 24.35 kg. FTMR has several advantages such as higher digestibility than non-fermented so that the nutrient content can be absorbed by livestock better. The fermented feed contains a lot of good bacteria that the cows' digestive can convert it into a source of non-nitrogen protein (NPN). The advantages of using soybean straw as feed is it contains phytoestrogens that are beneficial to improve the health and reproductive performance of postpartum cattle, including shorter mating intervals. Application of good quality feed for 6-8 weeks to pregnant cows will affect the hypothalamus stimulating pituitary anterior to increase the release of Follicle Stimulating Hormone (FSH) in process of follicular maturation and growth and the operation of luteinizing hormone (LH) in stimulating lust [17–18].

The expression of nutritional adequacy from cows can be easily observed based on body condition score. The low body score will affect the reproductive performance of cattle that will be low also. As well as the medium body score describes the adequacy of better parent nutrition and its reproductive performance is expected to be better too. The BCS of cow fed by complete feed with control was 3.5 vs 2.8. The mating interval of BCS value 3.5 was 45.5 days that was shorter than that of BCS control 2.86, which the mating interval was 58.5 days. The main factors that influence the duration of postpartum anesthesia in cattle include nutritional status (measured by BCS) and breastfeeding [5].

4. Conclusion

According to this research, Soybean waste as feed ingredients made into fermented TMR formula have high-quality nutrients. The results of in vitro feed analysis showed that feed digestibility of fermented TMR was better than non-fermented TMR. Pregnant cows administered with feed treatment have a significant effect on shorter mating interval.

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