# Improving the productivity of Joper chickens with fermented soy milk waste (SMW)

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**Abstract.** The productivity of Joper chickens can be increased by improving feed quality using fermented *soy milk waste* (SMW). This research was carried out using 100 day olds chick (DOC) Joper in healthy conditions using a completely randomized design (RAL). The 5 dietary treatments of fermented SMW at levels in feed (0, 5, 10, 15 and 20%) with each treatment consisting of 5 DOC Joper and was repeated 4 times. SMW in this study was fermented using effective microorganism 4 (EM-4) at a dose of 7.50% of the weight of SMW. Statistical analysis showed that the fermented SMW level significantly ($p<0.01$) increased feed intake, body weight gain and body weight of Joper chickens and reduced mortality and FCR. The average feed intake ranged from 2071.50-2207.00 g/head; body weight gain (14.71-25.55 g/bird/day); body weight (556.00-934.25 g/bird); mortality (0.84-1.25%) and FCR (2.34-3.75). It can be concluded that improving feed using fermented SMW can increase the productivity of Joper chickens. The best productivity of Joper chickens was using 15% SMW.

## 1 Introduction

Joper is a local chicken that is widely cultivated and has become the preferred breed for the broiler chicken farming community in Indonesia. Joper is a chicken that is produced from crossing commercial laying hens with native roosters, and it has better performance than native chickens in general [1–3]. The growth of Joper chickens is better than that of native chickens in general, where a weight of 0.8-1.0 kg/bird can be achieved at the age of 60 days, while native chickens generally achieved market weight at the age of 3-4 months [1,4,5]. The development of the Joper chicken production has a huge opportunity because the native chicken population is not yet able to supply the increasing demand for native chicken meat. The demand for native chicken meat can only be supplied at 30% of the total national demand in 2019 [6–8]. Feed plays an important role in productivity and is also the largest component

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of production costs in the Joper chicken production [9–13]. Lack of nutrition in Joper chickens causes low productivity and slow business development. One effort to increase the productivity of Joper chickens is by improving feed quality using soy milk waste (SMW) [14,15].

Soy milk waste (SMW) is a solid waste by-product of the soy milk industry. The increase in soy milk consumption every year, especially in European countries, has an impact on increasing industrial waste as well. World soybean industry waste reaches 1.40 billion tonnes/year. This high level of waste is certainly a problem for the soy milk industry because it causes environmental pollution [16–18]. In Indonesia there are quite a lot of SMWs and the prices are also relatively cheap. SMW is a good feed ingredient for livestock because it has high nutritional content. The nutritional content of SMW includes metabolic energy of 2837-3033 kcal/kg, crude protein 24.00- 26.37%, crude fat 2.52- 8.31%, crude fiber 14.81-19.13% and ash 4.56-6.42% and isoflavones [16,17,19].

SMW also contains a high number of lactic acid bacteria (LAB) which can be used as a source of probiotics in poultry. Probiotics are a type of feed additive that can be used as an alternative to replace antibiotics. Probiotics can stimulate the microflora in the intestine to change the digestive tract to be better and more beneficial so that it can be used to increase feed efficiency and livestock productivity [20]. SMW not only has a high nutritional content, it also has quite a high anti-nutrient content including trypsin, phytic acid, lectin and tannin. This antinutrient is one of the limiting factors in the use of SMW as a feed ingredient [21,22]. Therefore, research is needed to suppress anti-nutrients from SMW through fermentation using a mixed inoculum of several types of microorganisms such as those contained in EM-4. Therefore, research is needed to improve the quality of feed using fermented soy milk waste (SMW) to increase the productivity of Joper chickens.

## 2 Materials and Methods

### 2.1 Experimental design and feed

This study was carried out using 100 day olds chick (DOC) Joper in healthy conditions using a completely randomized design (RAL). The birds were fed diets containing 5 levels of SMW (0, 5, 10, 15 and 20%) and each treatment used 5 DOC Joper and was repeated 4 times. SMW in this study was fermented using effective microorganism 4 (EM-4) at a dose of 7.50% of the weight of SMW. The microorganisms contained in EM-4 showed at Table 1. Joper chickens were placed in battery colony cages measuring 40x50x70 cm with each box containing 5 birds. The treatment feeding in the study was 40% of the feed given in the morning at 06.30 WIB and 60% of the feed given in the afternoon at 15.30 WIB. Drinking water was provided *ad libitum*. The composition of dietary treatments are shown in Table 2 below.

**Table 1.** Microbial content per 1000 ml EM-4

| Microbial composition | Concentration |
|---|---|
| *Lactobacillus casei* | $1.5\times10^6$ |
| *Saccharomyces cerevisiae* | $1.5\times10^6$ |
| *Rhodopseudomonas palustris* | $1.0\times20^6$ |

Data obtained from the EM-4 product brochure

**Table 2.** Composition of the diet

| Composition | Treatment | | | | |
|---|---|---|---|---|---|
| | F0 (0%) | F1 (5%) | F2 (10%) | F3 (15%) | F4 (20%) |
| **Ingredient (%)** | | | | | |
| Corn | 55.58 | 55.27 | 54.90 | 52.01 | 50.02 |
| Soybean meal, 45% CP | 26.90 | 25.30 | 21.00 | 18.96 | 16.40 |
| Fermented SMW | 0.00 | 5.00 | 10.00 | 15.00 | 20.00 |
| Rice bran | 7.60 | 4.50 | 4.17 | 3.80 | 3.35 |
| Meat bone meal | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Limestone | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Crude palm oil | 0.20 | 0.20 | 0.20 | 0.50 | 0.50 |
| Complete premix | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 |
| Salt | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Nutrient** | | | | | |
| Metabolic energy (kcal/kg) | 3,003 | 2,999 | 2,998 | 3,002 | 3,003 |
| Crude protein (%) | 21.00 | 20.99 | 20.99 | 20.99 | 20.99 |
| Crude fat (%) | 4.04 | 4.00 | 3.99 | 4.05 | 4.04 |
| Crude fiber (%) | 3.21 | 3.19 | 3.18 | 3.16 | 3.13 |
| Calcium (%) | 3,003 | 3,010 | 2,999 | 3,002 | 3,003 |
| Total phosphorus (%) | 21.00 | 20.98 | 20.98 | 21.01 | 21.00 |
| Ash (%) | 5.48 | 5.00 | 5.39 | 5.50 | 5.41 |

Calculation of feed composition using Brill Formulation software

## 2.2 Data collection

The parameters measured were feed intake, body weight gain, final weight and FCR. Calculations of feed consumption were generally carried out within 24 hours based on the total feed given and the amount of remaining feed and scattered feed [23,24]. Body weight gain of Joper chickens is an indicator of the efficiency of feed utilization used for chicken productivity. Body weight gain was determined by calculating the difference between the results of weighing chickens each week and the daily body weight gain of Joper chickens. Body weight was measured by weighing the Joper chickens at harvest (end of research). Feed conversion ratio (FCR) is one of the parameters to determine the level of efficiency of using

a feed. FCR in raising Joper chickens is a comparison between total feed consumption and meat production [7,15,25].

### 2.3 Data analysis

All data obtained in research is tabulated and analyzed using analysis of variance (ANOVA). Analysis of variance used a completely randomized design (CRD) where both laboratory and biological studies were carried out with 5 types of treatment and repeated 4 times for each treatment. Statistical analysis is continued with Duncan's test if the results obtained provide significant or very significant differences in influence.

## 3 Results and Discussion

The productivity of Joper chickens with feed treated using fermented SMW is presented in Table 3 below.

**Table 3.** Average productivity of joper chickens with rearing for 8 weeks using fermented SMW

| Treatment | Variable | | | | |
|---|---|---|---|---|---|
| | Feed intake (g/bird) | Body weight gain (g/bird/day) | Body weight (g/bird) | Mortality (%) | FCR |
| F0 (0%) | 2082.75$^{ab}$ | 14.71$^{a}$ | 556.00$^{a}$ | 1.25$^{c}$ | 3.75$^{d}$ |
| F1 (5%) | 2071.50$^{a}$ | 17.55$^{b}$ | 656.50$^{c}$ | 0.84$^{a}$ | 3.16$^{b}$ |
| F2 (10%) | 2207.00$^{c}$ | 25.55$^{c}$ | 934.25$^{e}$ | 0.84$^{a}$ | 2.36$^{a}$ |
| F3 (15%) | 2103.75$^{b}$ | 24.50$^{c}$ | 898.75$^{d}$ | 0.85$^{a}$ | 2.34$^{a}$ |
| F4 (20%) | 2075.75$^{a}$ | 16.79$^{b}$ | 630.00$^{b}$ | 0.98$^{b}$ | 3.30$^{c}$ |

Different superscripts in the same column showed that fermented SMW level was very significant ($p<0.01$) increased feed intake, body weight gain and final weight of Joper chickens and reduced mortality and FCR.

### 3.1 Feed intake

Statistical analysis showed that fermented SMW significantly ($p<0.01$) increased Joper chicken feed intake. The average feed intake for Joper chickens in this study ranged from 2071.05-2207.00 g/bird. The highest Joper chicken feed intake of 2207.00 g/bird was obtained when fermented SMW was used at 10% and the lowest Joper chicken feed intake was 2071.05 g/bird when fermented SMW was used at 5% of the total feed ingredients. The increase in feed intake from treated feed using fermented SMW was due to increased palatability. This improvement in palatability occurred attributed to an increase in the physical quality of SMW during the fermentation process [26]. SMW fermented using EM-4 had a crumblier texture so it is easier to digest and the color also changes to become brighter from dark brown to lighter in color.

The decrease in feed consumption when using SMW was 20% in the F4 treatment feed due to a change in the ratio of grain use, especially corn, where the proportion used became less due to an increase in the percentage of SMW in the feed (Table 2). Chickens prefer to consume feed in granular form rather than feed in mash form to meet their nutritional needs

[27,28]. The color factor of the feed also influences the palatability of chickens. Darker colored feed has lower palatability than lighter colored feed [29]. The decrease in feed consumption was due to the increased use of SMW in F3 and F4 is due to the fact that fermented SMW has a high nutritional content, a crumbly texture that makes it easier for the digestion process and a high content of lactic acid bacteria which can be used as a source of probiotics [15,30,31]. This means that joper chickens have had their nutritional needs met. When the Joper chicken's nutritional needs are met, the homeostatic regulation system in its body will give a signal for the chicken to stop eating so that the chicken naturally stops eating when its nutritional needs are met [5,32].

### 3.2 Body weight gain

Statistical analysis showed that EM-4 level significantly ($p<0.01$) increased the body weight gain of Joper chickens. The average body weight gain of Joper chickens in this study ranged from 14.71-25.55 g/bird/day. The highest body weight gain for Joper chickens of 25.55 g/bird/day was obtained when fermented SMW was used at 10% and the lowest Joper chicken body weight gain was 14.71 g/bird/day when fermented SMW was used at 0% of the total feed ingredients. Body weight gain in Joper chickens increased with increasing percentage of fermented SMW in the feed. The fermentation process makes SMW digestibility high due to improvements in the physical quality and nutritional quality of SMW[26]. Fermented SMW has a high isoflavone content which makes joper chicken healthier. Isoflavones are polyphenolic compounds that work as antioxidants and can increase body fat metabolism [15]. SMW is a solid waste from soy milk processing which is rich in lysine and tryptophan. Lysine is an amino acid that functions as a precursor for antibodies, improving the body's circulation system and cell growth. Tryptophan is an amino acid that functions to stimulate the release of growth hormone [17].

### 3.3 Body weight

Statistical analysis showed that EM-4 level significantly ($p<0.01$) increased the body weight of Joper chickens. The average body weight of Joper chickens in this study ranged from 556.00-934.25 g/bird. The highest body weight of Joper chickens was 934.25 g/bird, obtained when fermented SMW was used at 10% and the lowest body weight at Joper chickens was 556.00 g/bird, obtained when fermented SMW was used at 0% of the total feed ingredients. The increase in Joper's body weight given feed with fermented SMW is related to the amount of feed intake and the nutritional quality of the fermented SMW. Low feed intake has an impact on low body weight [3,15].

Metabolic activity during fermentation in SMW makes SMW rich in antioxidants due to increased isoflavone content and phenolic compound content [21]. Phenol is a substance that has an aromatic ring with one or more hydroxyl groups. Phenol is reported to be able to inhibit enzyme activity, bind to sulfhydryl groups and proteins in bacteria so that it can be used as an antibacterial [33]. The high content of phenolic compounds has an effect on improving digestive tract health in Joper chickens so that feed absorption is maximized and feed efficiency increases. The use of 20% fermented SMW in F4 resulted in lower body weight compared to F2 and F3 because the phenol content in the digestive tract of Joper chickens was too high. This actually has a negative impact because phenol that exceeds the threshold in the digestive tract can damage bacterial cell walls and inhibit the growth of lactic acid so that feed absorption cannot be maximized.

### 3.4 Mortality

Statistical analysis showed that EM-4 level significantly ($p<0.01$) reduced the mortality of Joper chickens. The average mortality of Joper chickens in this study ranged from 0.84-1.25%. The highest mortality for Joper chickens was 1.25% when fermented SMW was used at 0% and the lowest mortality at Joper chicken was 0.84 when fermented SMW was used at 10% and 15% of the total feed ingredients. In general, mortality in this study was in the normal category because the mortality rate was below the mortality standard, where the mortality standard for Joper chickens during their growth period was 5% [3]. The mortality rate in Joper chickens is related to nutritional adequacy [15,17]. The use of fermented SMW in feed can reduce mortality rates because SMW has high and complete nutrition which supplies the nutritional needs of Joper chickens [15]. SMW also contains high levels of lactic acid bacteria (LAB) as a source of probiotics for Joper chickens which are useful for improving digestive tract health and improving feed nutrition to support optimal antibody synthesis [20]. The high antioxidant content in SMW is useful for maintaining the health of Joper chickens by suppressing free radicals. Free radicals that are too high in the body can reduce immunity in chickens [15].

### 3.5 FCR

Statistical analysis showed that EM-4 level significantly ($p<0.01$) reduced the FCR of Joper chickens. The average FCR of Joper chickens in this study ranged from 2.34-3.75. The highest FCR for Joper chickens was 3.75 when fermented SMW was used at 0% and the lowest FCR at Joper chicken was 2.34 when fermented SMW was used at 15% of the total feed ingredients. The use of fermented SMW in Joper chicken feed can reduce the FCR value because SMW contains a high isoflavone content which can function to improve health in the digestive tract [15,17]. SMW contains large amounts of Lactobacillus sp bacteria which are useful as probiotics for chickens to suppress disease, increase body weight and improve feed conversion. Total feed intake and body weight of Joper chickens also play an important role in determining the number of FCR [34].

## 4 Conclusions

This research can be concluded that improving feed using fermented SMW can increase the productivity of Joper chickens. The best productivity of Joper chickens was using 15% fermented SMW.

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