The effect of the addition of Indigofera flour and red ginger powder in feed towards slaughter, carcass and quality of meat of sensi chicken

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Abstract. This study aim was to determine the effect of the addition of Indigofera flour and red ginger powder in the feed on slaughter, carcass and quality of meat of Sensi chicken which includes protein, fat and cholesterol contents. The research used 36 male Sensi chickens that kept from the age of 4 weeks to 19 weeks in Experimental Garden of Gowa, The Assessment Institute of Agriculture Technology South Sulawesi. The design used was a complete randomized design divided into three treatments and 12 replications. The treatment of feed given is as follows: R1: 100% commercial feed; R2: commercial feed 75%, Indigofera flour 10% bran 5%, corn 9%, red ginger powder 1%; R3: commercial feed 50%, Indigofera flour 15% bran 9%, corn 25%, red ginger powder 1%. The results showed that the feed treatment significantly affected (P < 0.05) on the slaughter weight and carcass weight of Sensi chicken where R3 treatment produced the highest slaughter weight and carcass weight compared to other treatments, which was 1728.16 g/tail/day and 1398.33 g /tail/day. The results of quality meat analysis in the form of crude protein, crude fat and cholesterol showed that R2 treatment had the highest crude protein content (25.74%), fat content (0.16%) and cholesterol (54.7%) the lowest compared to other treatments. The conclusion was that the addition of Indigofera flour and red ginger powder in feed gave the highest slaughter weight and carcass weight of Sensi chicken and could increase meat protein content, reduce fat and cholesterol content of meat Sensi chicken.

1. Introduction
Indonesia is rich in genetic resources, including various types of native and migrant native chickens, which spread throughout the islands [1]. One of the local chickens which is the result of innovation from the Research Institute for Animal Research and Development Agency of the Ministry of Agriculture is the Sentul Selected Chicken (Sensi) which is a type of local broilers. Sensi-1 Chicken Agrinak is a local Sentul chicken that has been selected for growth for six generations [2]. Furthermore, [3] explained that the characteristics of the Sensi chicken have the colour of grey feathers and the colour of the feathers of the puck (black patches white) for males and females. At the age of 70 days, the male cut weight reached 1.066 g/head and female to 745 g/head.

In poultry production, about 70% of the total cost is attributed to feeding value [4]. Therefore, for the native chicken farms to succeed, that is, chickens can grow and produce as expected with...
maximum profit levels, the feed factor must receive serious attention, especially the quality and price of feed [5]. A good meal contains all the nutrients and support to achieve optimal growth. Animal growth will affect the weight of slaughter, carcass weight and ultimately will affect the percentage of the carcass [6]. Alternative feed ingredients open an opportunity to lower feed costs by utilising new materials that are available locally [7] to reduce competition between humans and poultry for standard components and reduce feed costs [8].

Indigofera sp. is a type of tree legume which has high productivity and good nutrient content, especially its high protein content. Indigofera has been widely used as cattle feed but is still not widely used as chicken feed. This plant is used as animal feed which is rich in nitrogen, phosphorus, potassium and calcium [9]. The nutritional content of Indigofera sp one-year-old plants with three-month cutting intervals contained an average of 23.20% crude protein, 90.68% organic matter, 36.72% NDF, 0.83% phosphorus and 1.23% calcium content [10].

Red Ginger (Zingiber officinale) is one of the herbs that is used as a substitute for antibiotics which contains many bioactive components in the form of oleoresin and ginger essential oil which function to help in optimising the role of body organs [11]. The purpose of this study was to determine the effect of the addition of Indigofera flour and red ginger powder in the feed on slaughter weight, carcass weight and quality of meat of Sensi chicken.

2. Materials and Methods
The study was conducted in the Experimental Garden of Gowa; South Sulawesi Pabentengan village, Bajeng sub-district, Gowa Regency, The Assessment Institute of Agriculture Technology in South Sulawesi Indonesia. Using a stage cage made of bamboo slats measuring 120 cm x 100 cm x 50 cm as many as six pieces each pen consists of 6 male Sensi chickens so that a total of 36 Sensi chickens. Sensi chickens raised from the age of 4 weeks to the period of 19 weeks. The study used a completely randomised design divided into three treatments and 12 replications, the composition of the ration and dietary content of the research rations given presented in Table 1.

| No | Ingredient                  | Treatment (%) | R1   | R2   | R3   |
|----|-----------------------------|---------------|------|------|------|
| 1  | Commerical feed             |               | 100  | 75   | 50   |
| 2  | Local ingredient            |               |      |      |      |
|    | Bran                        |               | 0    | 5    | 9    |
|    | Indigofera flour            |               | 0    | 10   | 15   |
|    | Maize flour                 |               | 9    | 25   |      |
|    | Red ginger powder           |               | 0    | 1    | 1    |
|    | Amount                      |               | 100  | 100  | 100  |
|    | Crude Protein (%)*          |               | 16.54| 16.94| 16.71|
|    | Metabolic energy (kcal/kg)* |               | 3431 | 3288 | 3393 |
|    | Crude fat (%)*              |               | 5.11 | 5.27 | 6.26 |
|    | Crude fiber (%)*            |               | 0.12 | 5.18 | 5.60 |

* Source: The animal Feed Chemistry Laboratory of the Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia, 2019.

Stages of making Indigofera flour: (1) Fresh Indigofera leaves harvested from the Experimental Garden of Gowa are aerated without direct sun exposure for ± one day to not change colour, (2) then dried in the sun for ± 10 hours, then ground to form flour.

Stages of making red ginger powder: (1) red ginger cleaned, then thinly sliced and then dried for three days, (2) after it is dry then blended using a hammer mill to form a flour. The feed was given
according to the age of the livestock. Clean drinking water at room temperature provided as much as 200 ml/head/day.

Table 2. Provision of research feed

| Age (week) | Feed requirements (g/head/day) |
|------------|--------------------------------|
| 0 - 1      | 10                             |
| 1 - 2      | 15                             |
| 2 - 3      | 20                             |
| 3 - 4      | 25                             |
| 4 - 5      | 30                             |
| 5 - 6      | 40                             |
| 6 - 7      | 50                             |
| 7 - 8      | 70                             |
| 8 - 9      | 90                             |
| 9 - 19     | 100                            |

2.1. Measured Parameters

2.1.1. Slaughter weight and carcass weight.
Slaughter weight measurements are the final weights of 19-week-old chickens before slaughtering. After that, the chicken is fasted for about 8 hours and then cut manually using a knife with the Kosher method, reducing the carotid artery, jugular vein, trachea and oesophagus.

2.1.2. Quality of meat.
Quality of meat in the form of crude protein, crude fat and cholesterol content. The nutrient content of carcass crude protein and crude fat obtained by the proximate method [12]. Crude protein and crude fibre analysed in the animal feed chemistry laboratory of the Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia. Cholesterol content analysed in the analysis and calibration laboratories of the Indonesian Ministry of Industry’s Agro-Industry Center based on the AOAC.

2.2. Data Analysis
Slaughter weight and carcass weight data were analysed using a completely randomised design [13]. The data obtained were analysed by diversity analysis (ANOVA), using the General Linear Model procedure according to SPSS instructions (version 23). If the diversity analysis results show that the real effect followed by Duncan’s multiple range test [14]. The linear model of diversity analysis is:

$$Y_{ij} = \mu + \alpha_{ij} + \varepsilon_{ij}$$

Where:

- $Y_{ij}$ = observed variable response
- $\mu$ = general average
- $\alpha_{ij}$ = the effect of the i-th feed on the j-th test
- $\varepsilon_{ij}$ = effect of the error component
- $i = 1, 2, 3, 4$
- $j = 1, 2, 3, 4$

3. Results and Discussion

3.1. Slaughter Weight and Carcass Weight
Table 3 shows the addition of Indigofera flour and red ginger powder in the feed had a significant effect ($P <0.05$) on the slaughter weight and carcass weight of the Sensi chicken. Duncan’s test shows that the slaughter weight and carcass weight of treatment R3 are significantly higher than R2 and R1, while the slaughter weight and carcass weight of treatment R1 are considerably lower than R2 and R3. Present the results and discussion in one section or in separate sections. Discuss/interpret the results concisely. Please prepare the table/figure according to the example below.
Table 3. Average slaughter weight and carcass weight of Sensi chicken

| Variable              | Treatment |        |        |
|-----------------------|-----------|--------|--------|
|                       | R1        | R2     | R3     |
| Slaughter weight (g/head/day) | 1605.41<sup>a</sup> | 1623.33<sup>b</sup> | 1728.16<sup>c</sup> |
| Carcass weight (g/head/day)  | 1221.25<sup>a</sup> | 1295<sup>b</sup> | 1398.33<sup>c</sup> |

R1: 100% commercial feed.
R2: commercial feed 75%, Indigofera flour 10%, bran 5%, corn 9%, red ginger powder 1%.
R3: commercial feed 50%, Indigofera flour 15%, bran 9%, corn 25%, red ginger powder 1%.
<sup>a,b,c</sup>Different superscripts following the same values on the same line showed significant differences (P <0.05)

Treatment R3 produced the highest slaughter weight of 1728.16 g/head/day, then the R2 treatment was 1623.33 g/head/day, and the lowest slaughter weight was treatment R1 amounted to 1605.41 g/head/day. These results indicate that the higher addition of Indigofera flour to the feed makes the Sensi chicken slaughter weight higher. The high slaughter weight in R3 treatment is suspected because it has a high protein content and high metabolic energy of 16.71% and 3393 kcal/kg. While the treatment of R2, although the crude protein content is high (16.94%), the metabolic energy content is lower than R1 and R3 at 3,288 kcal/kg. R1 treatment has the most top metabolic energy content of 3431 kcal/kg but has the lowest crude protein content of 16.54% so that it produces the lowest slaughter weight of 1605.41 g/head/day. Protein is one of the essential dietary macronutrients for animals, and as the critical component of cells, plays a vital role in the process of life. Growth rate and feed efficiency of chicken improves with the increase in dietary protein [15]. Energy intake is considered a fundamental factor in chicken production because it affects growth rate and carcass characteristics [16]; Fadillah et al. [17] also believes that energy required for the activities of life and the production of meat so that the energy shortage can cause stunted growth. Also, the addition of 1% red ginger powder to R3 makes more feed devoured and easily digested by an animal. In line with the opinion of Arifin et al. [11] that the main components of ginger are zingiberene and ginger, which can stimulate the digestive system by controlling pH, enzyme activity and microbial activity. The essential ginger extract can increase the appetite of poultry.

Furthermore, Herawati [18] reported that if excessive use of ginger would cause a negative (toxic) impact on the chicken’s body. Slaughter weight of Sensi chicken results of the study is more significant than female Sentul chickens research effects of [11] at the age of 75 days by 736 g. Besides Sensi Chicken is higher than other native chickens, among others, the weight of the Merawang chicken (Bangka chicken) at 11 weeks is 810 g [19], male village chicken at this age is 943.63 g [20]. It is also higher than the cut weight of 12-week-old male free-range chicken, the results of the study of Muryanto et al. [21] which is 713.70 grams.

Sensi’s chicken carcass weight that weighed was the weight of the empty carcass that is the result of processing chicken without blood, feathers, head, neck, legs and internal organs [22]. The addition of 15% Indigofera flour and 1% red ginger powder (R3) can produce carcass weight of 1398.33 g/head/day significantly higher than R2 treatment of 1295 g/head/day and R1 of 1221.25 g/head/day. These results indicate that the carcass weight is closely related to the slaughter weight of the chicken. In line with what was stated by Dewi et al. [23] that carcass weight is closely associated with slaughter weight and body weight gain. According to Solikin et al. [24], good carcasses must contain a lot of meat, low yields and not so high fat, all of which are affected by feed and maintenance.

3.2. Quality of Meat
The quality of Sensi chicken meat with feed treatment added with Indigofera flour and red ginger powder, including protein, fat, and cholesterol content, can be seen in Table 4 below.
Table 4. Quality of meat of Sensi chicken

| Variable                | R1     | R2     | R3     |
|-------------------------|--------|--------|--------|
| Crude protein (%)*     | 22.41  | 25.74  | 23.99  |
| Crude fat (%)*         | 0.22   | 0.16   | 0.17   |
| Cholesterol (mg/100 g)**| 64.7   | 54.7   | 57.7   |

* The Animal Feed Chemistry Laboratory of the Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia, 2019.
** Analysis and calibration laboratory for the Indonesian Center for Agro-Industry, Ministry of Industry, Bogor Indonesia, 2019.

The average meat protein content in this study ranged from 22.41% to 25.74%. This result is relatively high compared to several other studies, including research Rachma et al. [25] that uses super native chicken with cassava leaf skins ranging from 20.17 to 21.36%, almost similar to the results of Dewi [26], namely range of 19.38 - 20.68%. This study’s results approach the levels of meat protein in the study of Winedar et al. [27] which is 21.80 - 23.20% and Aberle et al. [28], which states that the protein content contained in chicken meat ranges from 16 - 22%.

Table 4 shows that R2 treatment has the highest protein content of Sensi chicken meat at 25.74% compared to other treatments, followed by R3 treatment at 23.99% and the lowest is R1 treatment at 22.41%. These results indicate that feed with the addition of Indigofera flour and red ginger powder affects Sensi chicken meat's protein content. But these results also suggest that the higher the Indigofera flour content, the lower the crude protein content of Sensi chicken meat. It suspected that this is due to the protein content of the feed added to the Indigofera flour and red ginger powder which is higher than that of commercial feed alone. The level of feed protein in the R2 treatment was higher than the other treatments by 16.94%, R3 treatment was 16.71%, while R1 had the lowest feed protein content of 16.54% (Table 1). That is by the opinion of Dewi [26] that the chemical nature of meat produced influenced by the food consumed if the protein in the feed increases it can increase the water content, protein and body ash and reduce body fat.

Fat content in this study ranged from 0.16% - 0.22%, relatively low compared to the results of research Rachma et al. [25] 1.43 - 1.70%; Dewi [26] is still in the range of viz 1.32 - 2.64%. Aberle et al. [28] stated that the fat content contained in chicken meat ranged from 1.2 - 12%. The R2 treatment had the lowest fat content of 0.16%, R3 treatment was slightly higher by 0.17%, and the highest was R1 of 0.22%. These results indicate that Sensi chicken fed with a mixture of Indigofera flour and red ginger powder has lower fat content than only commercial feed. Fat content and protein content produced are interrelated if the fat content is low, then the resulting protein content is high. These results are consistent with the opinion of Khasrad et al. [29] that protein content has an inverse relationship with fat content, where if the protein content is low then the fat content will be high and vice versa.

The cholesterol content of meat in this study ranged from 54.7 mg - 64.7 mg. The R2 treatment had the lowest meat cholesterol content of 54.5 mg/100 g, the R3 treatment was slightly higher at 57.7 mg/100 g, and R1 had the most top meat cholesterol content of 64.7 mg/100 g. These results indicate that Sensi chickens fed a mixture of Indigofera flour and red ginger powder have lower cholesterol content of meat compared to only commercial feed. The cholesterol content of meat in Sensi chicken also increases with the increase in the range of Indigofera flour in the feed. The low cholesterol content of Sensi chicken is thought to be due to a mixture of red ginger powder in R2 and R3 feeds. That is consistent with what was stated by Sari and Rahayuningsih [30] that red ginger (Zingiber officinale var. Rubrum) is one type of ginger that can reduce blood cholesterol. The content of gingerol in ginger has hypo cholesterol, anti-atherogenic effects and suppression of HMG-CoA reductase enzyme activity so that it can reduce the biosynthesis of total cholesterol. [31] reported supplementation of 5 g / kg ginger in the ration could increase SOD and GSHPx enzymes and reduce...
MDA in broilers aged 21 and 42 days. Decreased MDA levels indicate that the addition of ginger reduces lipid peroxidative damage to cells.

4. Conclusion
Based upon the results of the study concluded that addition of Indigofera flour and red ginger powder in feed gave the highest slaughter weight and carcass weight of Sensi chicken and could increase meat protein content, reduce fat and cholesterol content of meat Sensi chicken.

Acknowledgments
To Sunardi and the team, thank you for your assistance during our research.

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