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## Chemical characteristics of fermented broiler feather concentrate using different methods

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# Chemical characteristics of fermented broiler feather concentrate using different methods

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**Abstract.** In Indonesia, broiler feather waste is one of the most highly productive wastes. The utilization of broiler feather waste as raw material for feather concentrate has not been widely studied. Feather waste contains keratin protein. This protein is stable and difficult to digest. Therefore, we need a method to produce hair concentrate products that have nutritional value that can be utilized by other livestock. It is hoped that the use of bacteria in the fermentation process of broiler feathers will provide a solution. The purpose of the study was to evaluate the characteristics of broiler concentrate fermented using different methods. A total of four methods of the fermentation process were applied, M-A = Broiler Feather + *Bacillus subtilis* FNCC 0060, M-B = Broiler Feather + Autoclave + *Bacillus subtilis* FNCC 0060, M-C = Broiler Feather + 5%NaOH + *Bacillus subtilis* FNCC 0060, M-D = Broiler Feather + Autoclave + 5%NaOH + *Bacillus subtilis* FNCC 0060. *Bacillus subtilis* FNCC 0060 isolates were propagated for preparation for fermentation. The study was designed using a completely randomized design with a unidirectional pattern of 4 treatments and 3 replications. The results showed that the application of different fermentation methods using *Bacillus subtilis* bacteria only had a different effect on the parameters of fat content, while protein and crude fiber levels did not have a significant effect. The application of the M-C fermentation process treatment is a treatment with better results than the other treatments.

## 1. Introduction

Livestock waste is one of the problems on livestock in Indonesia. Waste that means waste in cattle, goats and chickens. This problem is a challenge that requires the right solution. One example of livestock waste that requires a solution is the production of feather waste from the broiler slaughtering industry.

Utilization of chicken feather waste is the focus of waste handling in the livestock industry. In addition, the use of liquid waste in the form of urine has also been widely developed. The use of liquid waste is more widely applied as a basis for making liquid organic fertilizers [1]. Several other livestock by-products have also been of concern to researchers recently. For example, skin and bones from cattle, also become very attractive potential to be developed. Extraction technology applications have been carried out to produce gelatin from bovine bone and material [2,3].

Based on statistical data, it shows that broiler meat production in Indonesia in 2018 reached 2,144,013 tons [4]. If the data is assumed that each broiler slaughtered has a live weight of 1.5 kg



perhead, then the number of broiler slaughtered is 1,429,324,000 birds. Based on the research results of Sa'adah (2013) showed that from each broiler slaughtered, approximately 4–5% of feather waste was obtained [5]. Based on these data, it means that the amount of hair production from broiler cutting reaches ( $4.5\% \times 1,429,324,000 = 64,319,580$  kg or equivalent to 64,319.5 tons).

From several research results, it was found that chicken feather waste can be produced into animal feed. The feather has a high protein composition reaching 80–90% [6]. Hair is composed of mostly keratin protein. Keratin is a structural protein that is insoluble in water, has epidermal tissue and hardens so that it is difficult to digest by livestock [7]. In addition, keratin is also composed of 8% disulfide bonds (S-S) which is an inhibitor of proteolytic enzymes [8].

The low digestibility of chicken feathers can be overcome by processing feather waste. There are 3 types of treatment process for hair waste, namely; 1) physical methods, 2) chemical methods and 3) enzymatic methods. Research conducted by Sari et al (2015) has applied physical and chemical methods in processing feather flour [6]. In addition, Williams et al (1991) processed feather flour using *Cunninghamella* mushrooms [9]. Other studies have been conducted by Said et al (2018) by applying the chemical hydrolysis method using HCl and NaOH [10].

The application of *Bacillus subtilis* bacteria in the hydrolysis of hair waste has high effectiveness and activity. However, this application has not been widely reported by previous researchers. The application of the hydrolysis process method to the feather waste and the time of the hydrolysis process will determine the final quality of the feather flour. Therefore, it is necessary to do in-depth research related to the method of the hydrolysis process and the time of the hydrolysis process and its interactions. The purpose of this study was to evaluate the effect of applying several hydrolysis methods on the chemical properties of chicken feather flour.

## 2. Materials and methods

### 2.1. Materials

The research material was broiler feather waste obtained from the Daya market, Makassar city, Indonesia.

### 2.2. Methods

**2.2.1. Treatments.** A total of four process methods were applied to feather waste, namely: M-A = Broiler Feather + *Bacillus subtilis* FNCC 0060, M-B = Broiler Feather + Autoclave + *Bacillus subtilis* FNCC 0060, M-C = Broiler Feather + 5%NaOH + *Bacillus subtilis* FNCC 0060, M-D = Broiler Feather + Autoclave + 5%NaOH + *Bacillus subtilis* FNCC 0060. The fermentation process was carried out for 7 days.

**2.2.2. Preparation of broiler feather samples.** Broiler feathers are taken from the Daya market, Makassar city, Indonesia. The feather were washed and dried using the sunlight for 7 days.

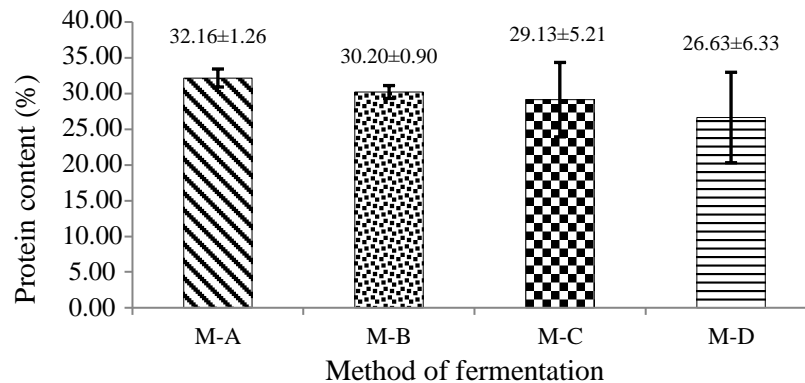
**2.2.3. Fermentation process.** Fermentation was carried out using *Bacillus subtilis*. FNCC 0060 bacteria obtained from the PAU Biotechnology Laboratory, Gajah Mada University, Yogyakarta, Indonesia. The fermentation time was carried out for 7 days. Fermentation was carried out using *Bacillus subtilis* FNCC 0060 bacteria obtained from the PAU Biotechnology Laboratory, Gajah Mada University, Yogyakarta, Indonesia. The fermentation time was carried out for 7 days. The stages of the fermentation process are: 1) First, the broiler feather sample is put into a bottle; 2). Next, the feather sample is put into an autoclave using a pressure of 21 psi for 10 hours. After that, the sample is put into the bottle; 3). The broiler feathers were then soaked using 5% NaOH for 2 hours. After that the sample is put into a bottle; 4). broiler feathers were put into the autoclave at a pressure of 21 psi for 10 hours. Then, soaked using 5% NaOH for 2 hours. After that the sample is put into the bottle. The sample in the bottle was fermented for 7 days under an-aerobic process conditions.

2.2.4. *Parameter and data analysis.* The parameters observed in this study were (1) crude fiber, (2) fat and (3) ash content. Data were analyzed using ANOVA [11].

### 3. Results and discussion

#### 3.1. Protein content

An overview of the differences in characteristics, especially protein content in feather flour using different fermentation methods is presented in figure 1.

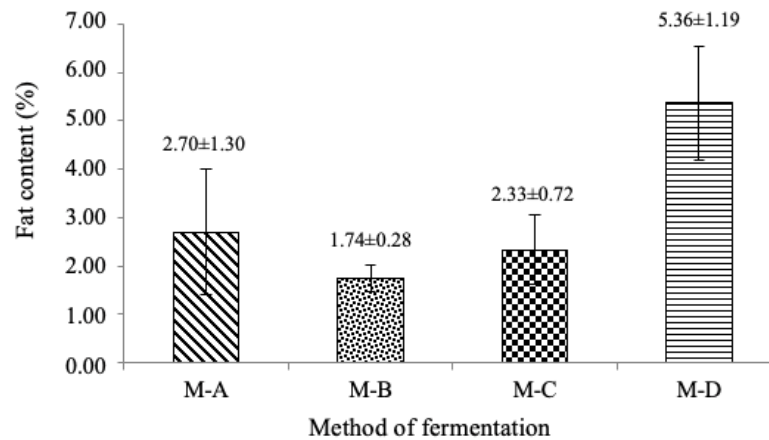


**Figure 1.** Characteristics of protein content (%) of broiler feather flour in the application of different fermentation methods; M-A (Method of A); M-B (Method of B); M-C (Method of C); M-D (Method of D).

Based on the ANOVA results in figure 1, it shows that the difference in the fermentation process method in chicken feather flour has no significant effect on protein content. The protein content of chicken feather flour obtained was in the range of 26.63%–32.16%. This data is very different from the results of the study [12]. These results show that the protein content of chicken feather flour is in the range of 85%. Different things were also obtained by Rasyaf (1993) who stated that the protein content in chicken feather flour reached 82–92% [13]. Other researchers [14] state that the crude protein in feather flour reaches 73.56%. The results of the protein content test obtained were lower than those of Said et al [15] (58.62–83.07%). This is probably due to the inactivity of the bacteria in the fermentation process.

#### 3.2. Fat content

The differences in fat content of feather flour processed using several different methods are completely presented in figure 2. The ANOVA (figure 2) results showed that the different fermentation methods applied were significantly different in the fat content of feather flour ( $P < 0.05$ ). The fat content in the feather flour shows a value range of 1.74%–5.36%.

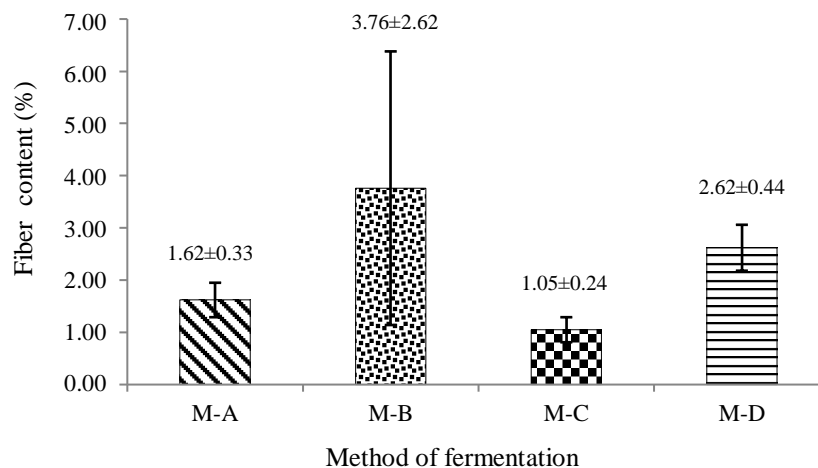


**Figure 2.** Characteristics of fat content (%) of broiler feather flour in the application of different fermentation methods; M-A (Method of A); M-B (Method of B); M-C (Method of C); M-D (Method of D).

The resulting data was different from the results of research [14] which stated that the fat content in chicken feather flour was in the range of 3.37%–10.9%. Likewise, shown by NRC (1996) that the fat in chicken feather flour is in the range of 3%–7.21% [16]. This shows that the fat content is quite low. The fat contained in feed is fat that cannot be dissolved in water [17].

### 3.3. Fiber content

The difference in the fiber content of feather flour produced using different processing methods is presented in figure 3.



**Figure 3.** Characteristics of fiber content (%) of broiler feather flour in the application of different fermentation methods; M-A (Method of A); M-B (Method of B); M-C (Method of C); M-D (Method of D).

The ANOVA results from the data in figure 3 show that the difference in the fermentation process using *Bacillus subtilis* bacteria does not affect the crude fiber content in broiler chicken feather flour ( $P>0.05$ ). Based on the results of previous research [14], it shows that the crude fiber content in broiler feather flour is in the range of 0.04%–0.08%. Based on these data, it shows that the value of crude fiber content in this study is higher (1.05%–3.76%) than previous studies.

#### 4. Conclusion

The difference in fermentation method using *Bacillus subtilis* FNCC 0060 bacteria in broiler feather waste for 7 days of fermentation resulted in different levels of fat, but protein and fiber content did not show any differences. Based on the research results, it is considered to use the M-C (Broiler Feather + 5%NaOH + *Bacillus subtilis* FNCC 0060) fermentation method to be applied in the fermentation process of broiler feather flour.

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