



## Effect of Replacing Rice Bran with *Aloe vera* and Sunflower in Fermented Feed on Carcass, Internal Organs, and Abdominal Fat of Broiler Chickens

(Pengaruh penggantian dedak dengan tepung lidah buaya dan biji bunga matahari dalam bahan pakan fermentasi terhadap berat karkas, organ dalam dan lemak abdomen ayam broiler)

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**ABSTRACT.** The purpose of this study was to examine replacement rice bran (RB) with the mixture of *Aloe vera* flour (AVF) + sunflower seed flour (SFS) within the fermented feed of which with the addition of other feed ingredients used to replace 25% of the commercial diet on carcass yields, internal organs, and abdominal fat of broilers. The study was conducted at the Field Laboratory of Animal Husbandry, the Faculty of Agriculture, Syiah Kuala University. The study used 100 chicks strain Cobb applied in a Completely Randomized Design with sub-samplings consisting of 5 treatments, 4 replicates, and 2 sub-samples. The treatments were 100% CP<sub>511</sub> (control+) and 4 FF-based diets: FF<sub>3%</sub> RB (control-), FF<sub>3%</sub> AVF, FF<sub>3%</sub> SFS, and FF<sub>3%</sub> AVF + 3% SFS. The results of this study showed that replacing rice bran with AVS and SFS either exclusively or in combination in equal amount 3% each did not significantly affect ( $P>0.05$ ) the percentages of the carcass, cut-ups, internal organs, and abdominal fat of broilers. In conclusion, either *Aloe vera* or sunflower seed flour could be incorporated 3% each in a single source or in combination to replace rice bran within the fermented feed. without adverse effects on carcass yields and internal organs as well as abdominal fats of broilers.

**Keywords:** *Aloe vera*, broiler, carcass, internal organs, sunflower seed

**ABSTRAK.** Penelitian ini bertujuan untuk mengamati pengaruh penggantian dedak padi (DP) dengan campuran tepung lidah buaya (TLB) dan biji bunga matahari (TBM) dalam bahan pakan fermentasi yang tersusun ~~dan~~ beberapa bahan pakan lain yang digunakan untuk menggantikan 25% ransum komersil terhadap berat dan persentase karkas, organ dalam, dan lemak abdomen ayam broiler. Penelitian dilakukan di Laboratorium Lapangan Peternakan (LLP), Fakultas Pertanian, Universitas Syiah Kuala. Penelitian menggunakan 100 ekor anak ayam broiler strain Cobb. Rancangan yang digunakan adalah Rancangan Acak Lengkap sub sampel terdiri dari 5 perlakuan, 4 ulangan, dan 2 sub sampel. Hasil penelitian memperlihatkan bahwa penggunaan TLB yang dicampur dengan TBM masing-masing sebanyak 3% tidak berpengaruh nyata ( $P>0,05$ ) terhadap berat dan persentase karkas, organ dalam, dan lemak abdomen ayam broiler. Kesimpulannya, TLB dan TBM masing-masing 3% ataupun campurannya 6% dapat digunakan untuk menggantikan dedak padi dalam bahan pakan fermentasi.

**Kata kunci:** Biji bunga matahari, broiler, karkas, lidah buaya, organ dalam

### INTRODUCTION

Recently, raising broilers have been expanded to produce healthier birds fed the herbal-base diets to confront the issues of potential residual carcass infected by any antibiotic usages. Numerous plant sources have been studied about their medicinal benefits for poultry but their applications in broiler diets have been reported in several contradictions. The leaves were the most common fragments of the plants that intensely investigated their beneficial compounds. Unfortunately, the digestive system of the avian is not prepared to allow highly leaf-base feed not only because of its poor digestibility but also its potential improper nutrients required for a bird. Many previous studies also reported the plant leaves ordinarily deserted in low acceptable taste

for the chickens. Many workers have manipulated the utilizations of the leaves in various treatments to make those more useful. This leaf may take in *Aloe vera*.

*Aloe vera*, a cactus-like plant, has been used for traditional medicinal purposes for thousands of years. According to Christaki and Florou-Paneri (2010), *Aloe* leaves can be separated into two basic products: the latex, a bitter yellow liquid beneath the epidermis of the leaf and the gel, a colorless and tasteless substance in the inner part of the leaf. Both have many biologically active components mainly *anthraquinones* and polysaccharides. The most active compound is *acemannan* which may act alone or in synergy. This plant seems to treat a variety of conditions because of its wound healing, anti-inflammatory, immunity, anti-diabetic, antioxidant, laxative, antibacterial, antifungal, antiviral, and antitumor effects. Melliawati (2018) reported that the gel of *Aloe* contains innumerable minerals such as calcium, magnesium, potassium, sodium, ferrum,

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zinc, and chromium, and its protein is rich in amino acids such as *leucine*, *lysine*, *valine*, and *histidine*. *Aloe vera* contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids (possesses anti-inflammatory and antibacterial properties), and 7–8 essential amino acids (Surjushe *et al.*, 2008).

The *Aloe* can be included in the animal or poultry diet to utilize their values to the maximum extent such as in medicine of animals (Mehala and Moorthy, 2008; Christaki and Florou-Paneri, 2010). The *Aloe* plant easily grows in widely land conditions which may include farm areas and the plants can be cultivated in pots. The limited constraints of feeding *Aloe vera* flour (AVF) to broilers were supposed to have its bitter taste and low protein content, approximately 3.29–4.70% (Ramadhia *et al.*, 2012). Therefore, the AVF was better exposed not exclusively to the poultry diet. Mehala and Moorthy (2008) combined *Aloe vera* and *Curcuma longa* flour with the equal amount of 0.2% each with the results either included solely or in combination were no significant differences ( $P > 0.05$ ) on the percentage of carcass and abdominal fat of broilers. Another alternative feed source with moderate protein content possible combined with the AVF was sunflower seed (SFS).

Sunflower seed is collected from the sunflower plant (*Helianthus annuus L.*). It is not the same as a sunflower meal (SFM). The SFM is a by-product of the sunflower oil industry and has been increasingly added to animal and birds diets. It consists of 60–65% crude protein (CP) core (kernel) and 35–40% hull (shell) and is an acceptable feed component of poultry rations and can be fed at 25% in broiler diet (Alagawany *et al.*, 2015). While the sunflower seed (SFS) is the complete seed including the hull, and the sunflower kernel (SFK) is the seed with the hull removed (OECD, 2007). The sunflower seed is sometimes called full-fat sunflower seed (FFSF). The whole SFS contained 18.7% CP (Hartadi *et al.*, 2005) and may vary depending on different types or areas such as 22.96% in Egyptian SFS or 21.22% in Chinese SFS (Hamed *et al.*, 2012). The SFS can be formulated into the poultry diet as a plant protein source. The SFS should be considered rich in energy since it has from 3.691 to 5.004 kcal of ME  $\text{kg}^{-1}$  (Mahfoudh *et al.*, 2016). The limiting factor of employing SFS in broiler diet is high crude fiber (CF), approximately 27.3% (Hartadi *et al.*, 2005). Hamed *et al.* (2012) reported the whole SFS contained 34.91 and

31.51% CF in Egyptian and Chinese SFS, respectively.

The proper concentrations of SFS in broiler diets have been reported in contradictory results existing in wide ranges depending on how the seeds are prepared. This may include such as hulled vs dehulled seeds. Whole seeds contain high crude fiber resulted from the hulls (coats) which are low digestibility. In another hand, dehulled seeds were the kernels, the digestible seeds. The possible variations on SFS could also be influenced by the processed seeds such as frying vs roasting processing. Garcia *et al.* (2021) reported that the fatty acid (FA) composition by GC-MS showed a higher amount of linoleic acid in sunflower seeds by frying process due to the replacement of the seed moisture by the frying oil and found six volatile characteristic compounds i.e. *butanal*, *2-methyl-butanal*, *1-hexanol*, *3-methyl-butanal*, *heptanal*, and *trans, trans-2,4-decadienal*. On the other hand, sunflower seeds by the roasting process by HS-SPME-GC-MS had a higher oleic acid content and found seven main volatile compounds i.e. *2-pentylfuran*, *2,3-dimethyl-pyrazine*, *methyl-pyrazine*, *2-octanone*, *2-ethyl-6-methylpyrazine*, *trimethyl-pyrazine*, and *trans, cis-2,4-decadienal*.

The serious barriers of both AVF and SFS are their less digestibility and palatability. It was suggested to constrain the offered concentration of both these feeds and better incorporating them in combination into the fermented feed. The rice bran (RB) has been commonly applied in fermented feed but its nutritional value to furnish important nutrients and support broiler health is so poor. Therefore, the AVF and SFS were considered instead of rice bran. It might be better not to use a single feed to perform fermented feed to replace 25% of the commercial diet. Identifying any difficulties on AVF and SFS, the other feed ingredients such as yellow corn, soybean meal, vegetable oil, and top mix were accompanied into the fermented feed. The purpose of this study was to examine replacement rice bran with the mixture of *Aloe vera* flour + sunflower seed flour within the fermented feed of which with the addition of other feed ingredients used to replace 25% of the commercial diet on carcass yields, internal organs, and abdominal fat of broiler chickens.

## MATERIALS AND METHODS

The study was conducted at the Field Laboratory of Animal Husbandry, Syiah Kuala University from 24 July until August 2020.

## Materials and Equipment

This study used 80 broiler chicks strain Cobb. The materials consisted of commercial diet CP<sub>511</sub>, *Aloe vera* leaves, unprocessed whole sunflower seeds, yellow corn, soybean meal, rice bran, vegetable oil, and top mix. The *Aloe* leaves and sunflower seeds were harvested at Field Laboratory of Animal Husbandry, Syiah Kuala University. The research was supported by 1 x 1 m cages of 20 units, brooders, feeders, drinkers, digital scales, disk mill, scalding, and dresser.

## Experimental Diets

This study used the commercial diet of CP<sub>511</sub> as a base diet as a positive control (CP<sub>511</sub>, control+). As much as 25% of the CP<sub>511</sub> was

removed then replaced with the fermented feed (FF) containing 9% rice bran (RB) to perform FF<sub>RB</sub>-diet (control-). As much as 3% of rice bran (RB) was replaced with *Aloe vera* flour (AVF) to perform the FF<sub>AVF</sub>-based diet, in another trial replaced with sunflower seed flour (SFS) with the same number to perform FF<sub>SFS</sub>-diet. Both AVF and SFS were included 3% each replacing 6% of rice bran to perform the FF<sub>AVF+SFS</sub>-based diet. Other feed ingredients formulated to the fermented feed were 4% yellow corn (YC), 9% soybean meal (SBM), 2% vegetable oil (VO), and 1% top mix (TM). The composition and nutrient contents of experimental diets were presented in Table 1.

Table 1. Composition and nutrient contents of experimental diets

| Feed ingredients                          | Fermented feeds (FF) |                  |                   |                   |                       |
|-------------------------------------------|----------------------|------------------|-------------------|-------------------|-----------------------|
|                                           | CP <sub>511</sub>    | FF <sub>RB</sub> | FF <sub>AVF</sub> | FF <sub>SFS</sub> | FF <sub>AVF+SFS</sub> |
| CP <sub>511</sub> diet <sup>1</sup>       | 100                  | 75.00            | 75.00             | 75.00             | 75.00                 |
| Fermented feed (FF)                       | 0.00                 | 25.00            | 25.00             | 25.00             | 25.00                 |
| Yellow corn <sup>2</sup>                  | 0.00                 | 4.00             | 4.00              | 4.00              | 4.00                  |
| Soybean meal <sup>2</sup>                 | 0.00                 | 9.00             | 9.00              | 9.00              | 9.00                  |
| Vegetable oil <sup>2</sup>                | 0.00                 | 2.00             | 2.00              | 2.00              | 2.00                  |
| Top mix                                   | 0.00                 | 1.00             | 1.00              | 1.00              | 1.00                  |
| Rice bran <sup>2</sup>                    | 0.00                 | 9.00             | 6.00              | 6.00              | 3.00                  |
| Sunflower seed flour (SFS) <sup>2</sup>   | 0.00                 | 0.00             | 0.00              | 3.00              | 3.00                  |
| <i>Aloe vera</i> flour (AVF) <sup>3</sup> | 0.00                 | 0.00             | 3.00              | 0.00              | 3.00                  |
| Total                                     | 100                  | 100              | 100               | 100               | 100                   |
| Calculated nutrient contents              |                      |                  |                   |                   |                       |
| Crude protein (CP, %)                     | 21.00–23.00          | 22.08–23.58      | 21.76–23.26       | 22.22–23.72       | 21.91–23.41           |
| Crude fiber (CF, %)                       | 5.00                 | 5.35             | 5.01              | 5.82              | 5.48                  |
| Ether extract (EE, %)                     | 5.00                 | 7.32             | 6.91              | 7.90              | 7.48                  |
| Methionine (%)                            | 0.50                 | 0.48             | 0.51              | 0.46              | 0.51                  |
| Lysine (%)                                | 1.00                 | 1.08             | 1.31              | 1.08              | 1.31                  |

<sup>1</sup> Based on the market label of CP<sub>511</sub> Bravo: CP 21.0–23.0%, EE 5%, CF 5%, Ca 0.9%, and P 0.6%; the methionine and lysine were in the assumption, <sup>2</sup> Chemical composition refers to Hartadi *et al.* (2005), <sup>3</sup> Chemical composition refers to Ramadhia *et al.* (2012); methionine and lysine (Djubaedah, 2003)

The treatment was:

CP<sub>511</sub> = 100% CP<sub>511</sub>(control+)

FF<sub>RB</sub> = 75% CP + 25% FF composted of 9% RB + 4% YC + 9% SBM + 1% TM + 2% VO + 0% AVF + 0% SFS (control-)

FF<sub>AVF</sub> = 75% CP + 25% FF composted of 9% RB + 4% YC + 9% SBM + 1% TM + 2% VO + 3% AVF + 0% SFS

FF<sub>SFS</sub> = 75% CP + 25% FF composted of 9% RB + 4% YC + 9% SBM + 1% TM + 2% VO + 0% AVF + 3% SFS

FF<sub>AVF+SFS</sub> = 75% CP + 25% FF composted of 9% RB + 4% YC + 9% SBM + 1% TM + 2% VO + 3% AVF + 3% SFS

## Experimental Design

This study used a Completely Randomized Design with sub samplings consisting of 5 treatments, 4 replicates, and 2 sub samples. Each replicate was an experimental unit containing 5 birds each. The statistical model for this

experimental design was:  $Y_{ijk} = \mu + \tau_i + \varepsilon_{ij} + d_{ijk}$  where  $Y_{ijk}$  = observation value,  $\mu$  = an overall mean,  $\tau_i$  = an effect due to diet,  $\varepsilon_{ij}$  = a sampling error, and  $d_{ijk}$  = a subsampling error (Steel and Torrie, 1991).

## Rearing Broilers

Broilers were raised in the experimental unit for 5 weeks old. The heating bulbs were set on for 24 hours/day during the first two weeks and 12 hours/day along the night of the 3<sup>rd</sup> week. For 4 weeks and over, the broodings were turned off all days. The birds were fed experimental diets *ad libitum* from the first day of placement until the last day of the 5<sup>th</sup> week. Drinking water was supplied *ad libitum* with administering vita stress during the first four weeks. The ND vaccine was delivered via eye drop on the third day and continued via intramuscular injection on the 21<sup>st</sup> day. While the IBD vaccine was proposed via mouth drop on the 10<sup>th</sup> day.

## Collecting the Data

At the end of the 5<sup>th</sup> week, all chickens were weighed individually. As many as two birds from each cage were selected with the criteria of average body weights in the subsampling close to it in the experimental unit. The sampling birds were placed into a bleeding cone and then killed and subsequently transferred into a scalding tank for a few minutes before going into the dresser. The dressed chicken was sliced in the abdominal region making an opening through which the viscera was pulled out off the body cavity. The examined internal organs were involved liver, gizzard, and heart. The liver was released from the attached membrane and excluded the kidney. Gizzard was cut out at the esophagus end and duodenum base on another side then sliced its outer muscle for cleaning the content. The heart was gathered by trimming out of the vein and arteria. The head and shanks were cut off then the neck removed resulting in a whole carcass without a neck. Next, a whole carcass was cut up into breast, thighs, wings, and back.

## Parameters

Parameters observed in this study were included weight and percentage of the whole carcass, cut-ups, giblets, and abdominal fat. The weights of all organs were measured by weighing those separately. The percentage of carcass was calculated by dividing carcass weight by live weight. While the percentages of cut-ups were counted by dividing every part by whole carcass weight. The percentage of internal organs was determined by dividing individual internal organ by live weight (LW).

## Data Analysis

All data were analyzed by Analysis of Variance (ANOVA). A Duncan's Multiple Range Test (DMRT) was applied to determine the differences among the treatments only if  $F_{\text{observation}} < F_{\alpha 0.05}$  (Steel and Torrie, 1991).

## RESULTS AND DISCUSSIONS

### Weights and Percentages of The Carcass

Weights and percentages of carcasses and cut-ups of broilers fed the fermented feeds (FF) with the inclusion of *Aloe vera* flour (AVF) and sunflower seed flour (SFS) were presented in Table 2. The result of ANOVA indicated no significant differences ( $P > 0.05$ ) in the weights and percentages of whole carcasses and all cut-ups among the groups.

The fermented feed formulated based on the mixture of *Aloe vera* + sunflower seed flour (FF<sub>AVF+SFS</sub>) did not result in a better whole carcass weight compared to those used solely either AVF or SFS (FF<sub>AVF</sub>, FF<sub>SFS</sub>). The carcass weight at FF<sub>AVF+SFS</sub> diet was close to at FF<sub>AVF</sub> and FF<sub>SFS</sub> diets. The results on cut-ups showed any related tendencies to whole carcasses. The AVF and SFS seemed in weak complements to produce high economic cut-ups. This indicated that at the given level there was no highly supplementary effect occurred between the AVF and SFS. Since both feeds were plant sources, the characteristics of their amino acids were presumably similar. According to Anggorodi (1985), a supplementary effect usually was built between plant and animal protein sources. The study reported by Zulfan *et al.* (2020) revealed a fish meal was mixed into Indigofera leaf to replace partially commercial diet with the result maintaining the egg production of the quails without significantly affecting feed conversion ratio (FCR) then getting an advantage in higher income. The low methionine in SFS (Hartadi *et al.*, 2005; Nenova and Drumeva, 2012) was supposed in inadequate amounts to support the lack of availability of these essential amino acids (EAA) supplied from AVF. Alagawany *et al.* (2015) showed that high levels of sunflower meal (SFM) in poultry diets can be used successfully with appropriate diet formulation adjustments for energy and amino acids particularly lysine and methionine.

Table 2. Weights and percentages of carcasses and cut-ups

| LW, feed consumption, and yields | Fermented feeds (FF) |                  |                   |                   |                       |
|----------------------------------|----------------------|------------------|-------------------|-------------------|-----------------------|
|                                  | CD                   | FF <sub>RB</sub> | FF <sub>AVF</sub> | FF <sub>SFS</sub> | FF <sub>AVF+SFS</sub> |
| Live weight (g)                  | 2069.4±166.6         | 1933.5±213.6     | 2003.3±145.2      | 1991.0±211.3      | 1924.1±158.2          |
| Feed consumption (g)             | 3111.1±67.8          | 2892.2±56.9      | 2954.3±113.3      | 2932.9±69.0       | 2857.1±89.7           |
| Whole carcass (g)                | 1504.4±113.7         | 1390.0±143.7     | 1397.9±106.5      | 1447.5±159.8      | 1384.1±108.1          |
| (%)                              | 72.80±3.59           | 71.97±2.03       | 72.50±3.43        | 72.71±2.51        | 72.07±1.40            |
| Cut-ups                          |                      |                  |                   |                   |                       |
| Breast (g)                       | 592.13±57.90         | 534.00±75.56     | 549.88±41.10      | 584.88±42.09      | 531.25±48.55          |
| (%)                              | 39.34±2.08           | 38.32±2.42       | 39.39±2.33        | 40.57±1.80        | 38.38±1.92            |
| Thighs (g)                       | 413.64±39.86         | 411.63±42.37     | 401.50±39.63      | 408.50±77.04      | 409.38±51.21          |
| (%)                              | 27.49±1.65           | 29.66±1.73       | 28.70±1.35        | 28.09±3.10        | 29.50±1.70            |
| Wings (g)                        | 149.13±8.18          | 143.25±13.98     | 143.00±11.53      | 142.38±15.72      | 136.38±7.87           |
| (%)                              | 9.94±0.62            | 10.32±0.53       | 10.24±0.63        | 9.84±0.35         | 9.88±0.64             |
| Backs (g)                        | 349.50±50.53         | 301.13±36.52     | 303.50±46.44      | 311.75±53.25      | 307.13±22.25          |
| (%)                              | 23.23±2.92           | 21.69±1.87       | 21.66±2.37        | 21.50±2.61        | 22.24±1.52            |

When the only AVF or SFS was formulated into the fermented feed (FF<sub>AVF</sub>, FF<sub>SFS</sub>), the weights of whole carcass and cut-ups exhibited closely to this from FF<sub>RB</sub> diet. It meant that either AVF or SFS could exclude 3% of rice bran in FF. By including both feeds in an equal amount of 3% each, the rice bran could be removed 6% out of the FF.

Although no significant differences, all FF diets tend to develop slightly lower yields rather than the CP<sub>511</sub> diet. The declined carcass weight was associated with the declined LW. While the cut-up weights were reflected from the carcass weight. Lower LW might be due to the reduced feed consumption of the broilers fed the FF diet. It was supposed all FF used in this study were less palatable. Although the vegetable oil (VO) was added into each FF, it seems not to help those too much. According to Anggorodi (1985), one of the beneficiaries of using fat in the diet is to enhance palatability. As reported by Azam *et al.* (2014), *Aloe vera* normally had in bitter taste even though non-bitter *Aloe* (NBA) was also found in arid parts of Rajasthan which were sporadically cultivated as a vegetable and for a health drink. A bitter taste was due to high *aloin* content (427.3 ppm in AV vs 4.1 ppm in NBA). However, LW and feed consumption in this study were not insignificant differences. This result agreed with Mohamed *et al.* (2017), the dietary treatments with up to 2.5% AVLP had no significant ( $P>0.05$ ) difference in final body weight and total feed intake when compared with the control group but the data on their Table 2 seemed both these parameters tend to lower in AVLP diets.

On another side, the taste of SFS has also been thought in poor palatability for the birds due to its higher lignification (Selvaraj and Purushothaman, 2004). In the recent study, the

hulled seeds of SFS were not processed except for drying under sunrise and crushed entirely before going in company with other feed ingredients to ferment resulting in high CF and also possible lignin. Almost 50% of the entire hull weights were cellulose and lignin (Cancalon, 1971). High CF and lignin dietary could depress feed intake. According to OECD (2007), sunflower hulls were not suitable for feedstuff due to the high CF content and the type of binding which causes a negative efficiency of energy utilization. A study by Arija *et al.* (1998) showed that the addition of up to 150 g kg<sup>-1</sup> (15%) full-fat sunflower kernel (FFSK) yielded a significant reduction ( $P<0.05$ ) in weight gain and feed consumption but not a significant difference at the addition of up to 50 g kg<sup>-1</sup> (5%) sunflower hulls (SH). However, in the recent study, the SFS was used in very low concentrates (not more than 3%) and both the kernels and hulls were included, additionally, the seeds run to ferment as well. Selvaraj and Purushothaman (2004) reported SFS up to 20% did not affect weight gain and feed consumption. Contrary report by Salari *et al.* (2009), weight gain and feed intake were improved ( $p<0.05$ ) when broilers were fed up to 210 g/kg (21%) of full-fat sunflower seed (FFSS) in the starter and finisher diets. In contrast to humans, Puraikalan and Sabitha (2014) reported that the sunflower seeds evaluated for human cookies are tasty food that sunflower seed flour recorded the highest scores for organoleptic parameters like color and appearance, flavor, crispness, taste, and overall acceptability even up to 30 days of storage.

The weight of carcass relative to LW did not show any significant differences ( $P>0.05$ ) among all groups. The carcass weights appeared in very near percentages with the range of 71.97–72.80%. This result indicated that the FF

based on AVF and SFS in an equal amount of 3% each either used separately or mixed and accompanied with other feed sources were able to replace up to 25% of the CP<sub>511</sub> diet without lowering the carcass proportion to the body weight. This result was in agreement with Sinurat *et al.* (2002) reported that the bioactive of AVF offered in the forms of dry and fresh gel and leaves could be used as feed additive with the level of up to 1 g/kg (1%) without affecting the percentage of broiler carcass. Kim *et al.* (2013) reported a total of 24 amino acids (AA) were detected in *A. vera* among other things *threonine* (Thr), *isoleucine* (Ile), *leucine* (Leu), *tyrosine* (Tyr), *phenylalanine* (Phe),  *$\beta$ -amino isobutyric* ( $\beta$ -AiBA), *histidine* (His), and *arginine* (Arg). The AA within AVM could be utilized by the broiler to perform carcass.

There were some confusions in earlier studies on AVF. Sunu and Abdurrahman (2019) stated that using an AVF-based diet at 0, 0.75, 1.5, and 2% significantly affected ( $P < 0.05$ ) carcass percentages of broilers showing the results of 70.83<sup>ab</sup>, 70.28<sup>ab</sup>, 69.71<sup>b</sup>, and 71.31%<sup>a</sup>, respectively. The percentages of carcasses appeared in very close numbers and hard to resolve the significant effects were detected to the control. Contrary reported by Mohamed *et al.* (2017) feeding 0 (control), 1.5, 2, and 2.5% *Aloe vera* leaves flour (AVLP) showed non-significant ( $P > 0.05$ ) differences in the carcass dressing among the experimental groups of broilers showing the results of 80.94 $\pm$ 6.69, 73.41 $\pm$ 0.49, 72.6 $\pm$ 1.22, and 72.01 $\pm$ 0.88%, respectively. The carcass dressing in the control diet seemed in an extremely high number with high variations compared to those in AVLP diets. With approximately 8.93% carcass percentage higher in the control group, regardless of statistic analysis, it hard to achieve the AVF diets did not affect the yields. The result of the recent study might not also balance with those studied by Mehala and Moorthy (2008) since they used a very low amount of *Aloe vera* mingled with *Curcuma longa* flour (0.2% each) in the diet that found no significant effect on broiler carcass.

The result of the FF<sub>SFS</sub>-based diet in the recent study was in agreement with Selvaraj and Purushothaman (2004), the dressing percentage of broilers fed up to 20% SFS was so close to the control (72.2–73.0% vs 72.0%). Salari *et al.* (2009) reported the percentage of breast and thighs of broilers fed up to 21% FFSS were not significantly affected. The result of this study is unequal to defend the study reported by Hermansyah *et al.* (2019) since they used very

high amounts of SFS (25–40%) in the diet causing significantly reduced final body weight (FBW) because of the progressive increase in CF (8.46–10.43%). Although SFS contains a moderate amount of protein and its amino acid profile is comparable to soybean meal, cottonseed meal, and coconut meal, the unprocessed whole seeds of SFS should not be explored in high amounts in the broiler diet otherwise the indigestible seeds may retard yield formation. Selvaraj and Purushothaman (2004) also reported the CF digestibility of SFS was significantly lower in a starter diet but comparable to all groups in the finisher diet while other nutrients such as protein either in starter or finisher diets were closely similar in all treatment groups.

### Weights and Percentages of Internal Organs

Weights and percentages of internal organs of broilers fed the fermented feeds (FF) with the inclusion of *Aloe vera* flour (AVF) and sunflower seed flour (SFS) were presented in Table 3. The result of ANOVA did not indicate any significant differences ( $P > 0.05$ ) in gizzard, liver, and hearth.

The result of the recent study agreed with Selvaraj and Purushothaman (2004), the weights (as % LW) of liver, heart, and gizzard in broilers fed up to 20% SFS were identical to the control. A similar result was also reported by Mohamed *et al.* (2017), feeding up to 2.5% AVLP was non-significant ( $P > 0.05$ ) differences in the liver (2.07–2.39%), gizzard (2.09–2.38%), and heart (0.43–0.55%). Conversely, the result on the liver was not under Salari *et al.* (2009) found significantly decreased ( $P < 0.05$ ) the relative liver weight in the broilers fed the FFSS diet compared to those fed the control diet. They supposed due to the nature of fat in FFSS which is composed mainly of unsaturated fatty acids, particularly linoleic acid because this fatty acid prevented fat accumulation in the liver. In contrast, Arija *et al.* (1998) reported there was a significant increase ( $P < 0.05$ ) in relative liver weight in chicks fed with increased concentrations up to 150 g kg<sup>-1</sup> (15%) FFSK but not significant at the levels up to 50 g kg<sup>-1</sup> (5%) SH in the diets.

The function of the liver and heart should also bear in mind that they strongly correlate to any anti-nutritional or toxicant factors that may contain within the feed. Consuming these compounds in high doses may accelerate these organ activities thus causing organ enlargements (Ressang, 1998). Table 3 showed the highest liver percentages found in the birds fed the diet with the SFS-based FF. The diets base on the FF<sub>AVF</sub> and

FF<sub>SFS</sub> also seemed to reveal higher heart percentages in comparison to CP<sub>511</sub> and the FF<sub>RB</sub>-based diet. Disregarding the toxicity, the dietary crude fiber (CF) donated from SFS were thought more responsible for both organ performances. However, the relative weight of these organs came out in the very short ranges releasing in normal limits. According to Putnam (1991), the relative weights of hearth and liver of broilers were 0.42–0.7% and 1.70–2.30%, respectively. So, slightly overweight liver within these studied birds should be connected to another function of this organ. The liver is the organ playing the greatest role in nutritional metabolisms such as fat, protein,

and carbohydrate. The broilers in the recent study have higher LW over likely those examined by Putnam (1991) signaling the possible differences in metabolism rate. The heavier birds are redirected to increase nutrient metabolism rather than the lighter birds. Nonetheless, statistically not significant differences ( $P>0.05$ ) were detected either on heart or liver among all groups. Therefore, exploring AVF and SFS in FF-based diets at the given levels should be accomplished no harmful to the broilers. The sunflower seed does not contain any natural anti-nutrients (OECD, 2007) and its protein is in the absence of toxic components (Nenova and Drumeva, 2012).

Table 3. Weights and percentages of giblets

| Internal organs | Fermented feeds (FF) |                  |                   |                   |                       |
|-----------------|----------------------|------------------|-------------------|-------------------|-----------------------|
|                 | CP <sub>511</sub>    | FF <sub>RB</sub> | FF <sub>AVF</sub> | FF <sub>SFS</sub> | FF <sub>AVF+SFS</sub> |
| Liver (g)       | 58.75±8.14           | 49.88±9.16       | 51.75±11.68       | 57.63±6.14        | 52.00±8.18            |
| (%)             | 2.83±0.25            | 2.58±0.44        | 2.70±0.67         | 2.92±0.40         | 2.71±0.40             |
| Gizzard (g)     | 33.13±5.72           | 34.00±3.89       | 34.13±3.31        | 37.00±8.40        | 32.50±4.34            |
| (%)             | 1.60±0.24            | 1.77±0.19        | 1.77±0.14         | 1.85±0.31         | 1.69±0.18             |
| Heart (g)       | 7.13±1.13            | 7.13±1.25        | 7.50±1.93         | 8.38±1.60         | 9.13±3.52             |
| (%)             | 0.34±0.05            | 0.37±0.04        | 0.39±0.02         | 0.42±0.07         | 0.47±0.16             |

The function of a gizzard of avian is to digest feed by working mechanically rather than enzymatically or biologically. Gizzard act was strongly affected by feed texture. Very rare information links the gizzard to feed toxicity. A rough feed could stimulate the gizzard to increase its activity causing the increased gizzard size. Table 3 showed the FF-based diets had quite a higher relative gizzard weight to LW than the CP<sub>511</sub> diet. The higher crude fiber and also possible lignin within FF primarily originated from RB, AVF, and SFS made the gizzards have to have extra work causing the increased gizzard percentage over the control (CP<sub>511</sub> diet). The digestive process runs gradually, then the absorption nutrient retarded, thus resulting in slow growth of the birds fed the FF-based diets. But, statically no significant differences were detected in this organ among all groups. In addition, the variety of gizzard percentages was ~~were~~ so diminutive and being considered in normal size. This result agreed with Salari *et al.* (2009), the

relative weight of the gizzard was not affected by the FFSS. Arija *et al.* (1998) reported no significant differences were detected concerning the relative weight of gizzard in broilers fed up to either 15% FFSK or 5% SH. This indicated using up to 5% SH did not hurt broiler gizzard. Therefore, the given levels of AVF and SFS and also RB in this study did not severely affect the gizzard. It could be explained that the fermentation treatment increased feed digestibility and minimize anti-nutritional compounds in the diet (Fardiaz, 1992).

#### Weight and Percentage of Abdominal Fat

Weight and percentage of abdominal fat of broilers fed the fermented feeds (FF) with the inclusion of *Aloe vera* flour (AVF) and sunflower seed flour (SFS) were presented in Table 4. The result of ANOVA did not show any significant differences ( $P>0.05$ ) in the weights and percentages of abdominal fats among the groups.

Table 4. The weights and percentages of abdominal fat of broilers

| Fat               | Fermented feeds (FF) |                  |                   |                   |                       |
|-------------------|----------------------|------------------|-------------------|-------------------|-----------------------|
|                   | CP <sub>511</sub>    | FF <sub>RB</sub> | FF <sub>AVF</sub> | FF <sub>SFS</sub> | FF <sub>AVF+SFS</sub> |
| Abdominal fat (g) | 23.25±8.60           | 21.00±6.39       | 20.88±9.79        | 18.25±5.60        | 22.38±3.6             |
| (%)               | 1.12±0.40            | 1.07±0.28        | 1.09±0.52         | 0.91±0.23         | 1.17±0.18             |

The FF based on AVF and SFS did not significantly influence ( $P>0.05$ ) broiler fat percentages. All birds from all treatments showed very tight numbers of the relative abdominal fat with the range of 0.91–1.17%. This result indicated that incorporating 25% FF based on AVF and SFS into the CP<sub>511</sub> diet kept maintaining the energy-protein ratio (EPR) at the optimum level. Including vegetable oil in the FF might not lead to an excessive amount of energy. This result agreed with Sinurat *et al.* (2002), the bioactive of AVF did not affect the abdominal fat percentage of broiler. A similar result was reported by Mohamed *et al.* (2017) there was a non-significant ( $P>0.05$ ) difference in the abdominal fat percentages in broilers fed up to 2.5% AVL<sub>P</sub>.

There were conflicting conclusions on the effect of sunflower seeds on abdominal fat deposits. The full-fat sunflower seed meal contains abundantly ether extract (EE), incorporating it at a high level into the diet potentially increases dietary fat. Selvaraj and Purushothaman (2004) reported abdominal fat was significantly increased in broilers fed 20% SFS. On the contrary, Salari *et al.* (2009) reported exposing up to 21% FFSS in the diet did not affect the abdominal fat of broilers even tend to decline. They assumed the reduction in this abdominal fat pad presumably returns a lower total body fat content and demonstrates the importance of fatty acids in modulating body fat. Mahfoudh *et al.* (2016) stated that the SFS was an excellent source of essential fatty acids (EFA) such as linoleic acid (LA) and oleic acid (OA). Arija *et al.* (1998) reported the relative weight of abdominal fat was not significantly affected by the addition of up to either 50 g kg<sup>-1</sup> SH or 150 g kg<sup>-1</sup> FFSK. In the recent study, the diet with SFS-based FF was administered at a low level of SFM that less contributed to produce fat pad. Table 4 showed the lowest abdominal fats were found on the birds fed the diet with SFS-based FF. However, many factors are involved in fat accretion.

## CONCLUSION

The conclusion of this study was using *Aloe vera* flour in combination with sunflower seed flour at the equal amount of 3% each did not result in better percentages of broiler carcass and cut-ups rather than using each solely in the same concentrates. However, either *Aloe vera* flour or sunflower seed flour could be incorporated 3% each in a single source or in combination to replace rice bran within the fermented feed to

complete 25% fermented feed of which 19–22% composed of other feed ingredients to replace partially commercial diet without adverse effects on carcass yields and internal organs (heart, gizzard, and liver) as well as abdominal fats of broilers. It was suggested to include animal protein sources such as fish meal into fermented feeds based on *Aloe* and sunflower seed fermented feed-based diets to meet an appropriate concentrate of dietary methionine.

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