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# The Effect of Fermentation of the Peel of Arabica Coffee with Win Prob Probiotics on Crude Fiber Content and Fiber Fraction

Fermentation  
of the Peel of  
Arabica Coffee

121

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## Abstract

**Purpose** – This study was conducted to determine the effect of peel of Arabica coffee (PAC) with Win Prob Probiotic on crude fiber content and fiber fraction (neutral detergent fiber, NDF; acid detergent fiber, ADF; cellulose; hemicelluloses; and lignin). The hypothesis of this study is that PAC fermentation using Probiotic Win Prob can decrease the content of crude fiber and fiber fraction.

**Design/Methodology/Approach** – The research design applied was a factorial completely randomized design with three treatments and three replications. Factor A (probiotic dose) consisted of three doses: 2.5%, 5%, and 7%, in addition, there are three fermentation durations considered as factor B, which are 20, 30, and 40 days.

**Findings** – The result of this study indicates that the content of crude fiber and fiber fractions can decrease each amount of the variable of this study. The best treatment was obtained in A3B3 with 7% probiotic with 30 days of fermentation. Rough fiber PAC decreased up to 27.66% and NDF content decreased by 3.6%. Moreover, ADF content decreased up to 4.10%. The last lignin decreased by 18.75%.

**Research Limitations/Implications** – Only a small portion of coarse fiber and fiber fractions in PAC is fermented with Win Prob probiotics. So we can try other ways to reduce the coarse fiber and PAC fiber fractions such as the combination of ammonium and fermentation (amofer).

**Originality/Value** – The PAC has a high content of crude fiber and fiber fractions (NDF, ADF, cellulose, hemicellulose, and lignin), and so it is recommended as ruminants for feed ingredients.

**Keywords** Peel of Arabica coffee, fermentation, probiotic, crude fiber, fiber fraction

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## 1. Introduction

The use of feed additive, such as an antibiotic, for livestock is no longer allowed. This is because the feed additive harms human health. The residue of antibiotics can remain in the livestock product that we consume. Nowadays, the technology of nutrition of livestock's wool has developed to include the advantages of natural materials. One of the technologies that is easy to be applied by the breeder is bioprocessing compost-heap by fermenting with probiotic. The fermented compost-heap with probiotic has many advantages: they increase the content of the compost heap's nutrition, decrease the crude fiber and fiber fraction (neutral detergent fiber, NDF; acid detergent fiber, ADF; cellulose; hemicellulose; and lignin), increase the digestibility level of the compost heap, stabilize the digested micro-flora, increase the efficiency of livestock ratio, and decrease the bad smell of livestock's dirt.

One ingredient in the compost heap that can potentially be processed to become the livestock's wool is the peel of Arabica coffee (PAC). The compositions elicited in the coffee are 45% of the peel of coffee, 10% mucilage, 5% husk, and 40% coffee stone. Thus, 1 ton seed of coffee will produce 450 kg of peel of coffee. If the peel of coffee is directly fed by the breeder to the livestock without any process, it has some disadvantages: they have a high composition of the crude fiber and fiber fraction (NDF, ADF, cellulose, hemicellulose, and lignin).

There have been many results by published studies, but it is inapplicable by the breeder because the microbe must be isolated and the material of fermentation must be sterilized. This method is not effective in use in the farm. On the other hand, there have been consensus that the breeder of livestock applied the fermented compost heap method to feed the livestock by using microbes. Although it is not sterilized, the nutrient content increases and the fermentation process continues. This probiotic contains six kinds of microbes and each consists of a group that has three kinds of mildews: *Aspergillus niger*, *Trichoderma viride*, and *Rhizopus oligosporus*. There are two classess of bacteria: *Basillus subtilis* and *Lactobacillus acidophilus*. Moreover, it has a class of leavened/yeast: *Saccharomyces cerevisiae*. Each microbe plays its own role in increasing the quality of the compost heap as the wool's of livestock, for example, *A. niger* and *T. viride* can decrease the crude fiber of the compost heap.

According to Budiari (2014), the content of crude fiber decreases from 18.74% to 13.05% after the compost-heap is fermented. Fermented rangsum has less crude fiber (Bidura, 2007). This phenomenon shows that the technology of microbes can make the peel of coffee more qualified as wool's livestock.

## 2. Materials and methods

The material used is 100 kg of PAC that was taken from the processing of the dry peel of coffee at Jln Takengon-Issac, Uning, Pegasing, Aceh Tengah. The probiotic used is Win Prob which is obtained from CV. MuktiAbadi, Perumahan Sidokare Indah Blok FF No. 8, Sidoarjo Jawa Timur.

In this study, fresh PCA was taken, sunbathed for two days, kept in the oven at 60 °C until the content of water was up to  $\pm 10\%$ . After that the rolling process was continued, followed by the fermentation of the peel of coffee using Win Prob probiotic mixed with sugar as the additional media to make the microbe grow well. In this study for each experiment 2.250 g of PAC was used and the content of water PAC applied was 10% of the content of water. For instance, in 7.5% dose of probiotic that contains 16.87 ml Win Prob liquid is prepared by adding 557 ml of water. In addition, this mixture needed 113 g of sugar. All the materials are mixed and put in plastic bags (two layers). Then they are placed in the hermetical room or anaerobe and incubated at 60°C. Then, they are analyzed by applying

approximate analysis (AOAC, 2012) dan (Van Soets, 1982) analysis (in the peel of fermented coffee and unfermented).

The data were analyzed by the analysis of variance with a completely factorial randomized design. The differences between treatment were tested further by Duncan's new multiple range test. Data processing was done with the SPSS program 17.0 for Windows Evaluation Version (Oramahi, 2008).

### 3. Result and discussion

#### 3.1 The effect of treatment on crude fiber in the fermented PAC

The averages of the content of crude fiber in the fermented PAC on different levels and the percent of probiotic and duration of fermentation can be seen in Table 1.

The result of the analysis shows that the interaction between the level of probiotic and the duration of fermentation effect is significantly different with regard to the content of the crude fiber. The PAC on the treatment in A3B2 got the best result on decreasing the crude fiber. Based on the best understanding of Fardiaz (1989) process, production of fermentation is influenced by the amount of starter, the kind of substrate, pH, temperature, and the duration of the incubation process. It agrees well with the process of Marlina (2004). Marlina found that the fermentation substrate of *Eichorniacrassies* with *A. niger* and its crude fiber content decreased from 24.6% to 19.00%.

This goes well with factor A, as the level of pro-biotic shows a significant different influence on the content of crude fiber ( $P > 0.01$ ). This phenomenon occurs because the more doses of microbes used, the more the content of crude fiber decreased. The pro-biotic bacteria named *T. viride* can diminish chitin of the bacteria and produce cellulose enzyme that can digest the cellulose in the peel of coffee (Guntoro, 2004). The higher the level of probiotic, the more the population of microbes; hence the cellulose enzyme production gets increased. According to Hartono in Mirnawati (2007) *A. niger* produces cellulose enzyme besides amylase, protease, glucomilase, lactase, catalase, glucoseoxidase, lipase, hemicellulose, and pectinases.

The result of Duncan Multiple Range Test (DMRT) elicited different the treatments got apparent contrast ( $P > 0.05$ ). The combination of treatment showed the best result for the content crude fiber that is the content of crude fiber is less than other treatment.

Based on the amount of crude fiber on the peel of coffee at Gayo highland, it can be categorized as wool as a source of fiber (roughage) because the content of crude fiber is more than 20%. The material wool can be categorized as concentrated wool if it contains more than 20% of crude fiber (Hartadi, 1980). Thus, because the peel of coffee at Gayo highland contains high crude fiber, it is not recommended to feed non-rhumancia livestock (fowl, horse, pig, etc.); however, it can be used to feed rhumancia livestock (cow, goat, sheep, etc.).

| Level of Pre-biotic (%) | Duration of Fermentation (Day) |                    |                    | Mean               |
|-------------------------|--------------------------------|--------------------|--------------------|--------------------|
|                         | 20                             | 30                 | 40                 |                    |
| A1: 2.5%                | 47.66                          | 49.31              | 48.65              | 48.54 <sup>a</sup> |
| A2: 5%                  | 40.18                          | 38.63              | 38.65              | 39.15 <sup>b</sup> |
| A3: 7.5%                | 38.57                          | 35.93              | 38.10              | 37.54 <sup>c</sup> |
| Mean                    | 42.14 <sup>a</sup>             | 41.29 <sup>b</sup> | 41.80 <sup>c</sup> |                    |

<sup>a,b,c</sup>Mean with different superscripts shows contrast different effects ( $P > 0.01$ ).

**Table 1.**  
The Effect of  
Treatment on Crude  
Fiber

3.2 The effect of treatment on the content of NDF

The average content of NDF in the fermented peel of coffee with various levels of pre-biotic and the different durations of fermenting can be seen in Table 2.

The results of the data analysis shows that the interaction among levels of probiotic and the duration of fermenting give a significantly different effect ( $P > 0.01$ ) on the content of NDF. Among the treatment given, there is an obvious different effect ( $P < 0.01$ ). Factor A (level of probiotic) and factor B (duration of fermenting) have the same elicited contrast different effect ( $P > 0.01$ ). The higher the level of probiotic, the longer the duration takes in fermenting the more the content of NDF obtained in the fermented peel of coffee. This is because the more the population of microbes and the more time it takes in fermenting the microbe produce cellulose and cilanase to reconstruct cellulose and xylene optimally, and this occurs because the content of NDF decreased goes hand in hand with the longer time taken in fermenting.

3.3 The effect of treatment on the content of ADF

The average content of ADF in the fermented peel of coffee on various levels of probiotic and different durations of fermenting can be seen in Table 3.

The result of data analysis shows the interaction among the levels of probiotic and the duration of fermenting. Among the treatment given, there is an obvious different effect ( $P < 0.01$ ). The phenomenon occurs because of the level of probiotic and the duration of fermenting. Factor A (level of probiotic) and factor B (duration of fermenting) have the same elicited contrast different effect ( $P > 0.01$ ). The higher the level of pre-biotics, the more the content of ADF obtained in the fermented peel of coffee. This is because the more the population of microbes, the more enzyme are produced to digest the substrate including ADF. According to Hartono in Mirnawati (2007) *A. Niger* produces cellulose besides other enzymes, such as amylase, protease, glucomilase, lactase, catalase, glucoseoxidase, lipase, hemicellulose, and pectinase. A fraction of ADF consists of cellulose, lignin, and silica.

**Table 2.**  
The Effect of  
Treatment on NDF

| Level of Pre-biotic (%) | Duration of Fermentation (Days) |                    |                    | Mean               |
|-------------------------|---------------------------------|--------------------|--------------------|--------------------|
|                         | B1                              | B2                 | B3                 |                    |
| A1 2.5%                 | 96.03                           | 95.21              | 95.11              | 95.45 <sup>a</sup> |
| A2 5%                   | 93.73                           | 90.74              | 88.03              | 90.83 <sup>b</sup> |
| A3 7.5%                 | 93.65                           | 91.27              | 93.84              | 92.92 <sup>c</sup> |
| Mean                    | 94.47 <sup>a</sup>              | 92.41 <sup>b</sup> | 92.33 <sup>c</sup> |                    |

<sup>a,b,c</sup>Mean with different superscripts show contrast different effect ( $P > 0.01$ ).

**Table 3.**  
The Effect of  
Treatment on ADF

| Level of Probiotic (%) | Duration of Fermentation (Days) |       |       | Mean               |
|------------------------|---------------------------------|-------|-------|--------------------|
|                        | B1                              | B2    | B3    |                    |
| A1 2.5%                | 60.75                           | 61.67 | 61.06 | 61.16 <sup>a</sup> |
| A2 5%                  | 61.17                           | 57.81 | 60.36 | 59.78 <sup>b</sup> |
| A3 7.5%                | 54.98                           | 58.01 | 59.86 | 57.62 <sup>c</sup> |
| Mean                   | 58.97                           | 59.17 | 60.42 |                    |

<sup>a,b,c</sup>Mean with different superscript show contrast different effect ( $P > 0.01$ ).

### 3.4. The effect of treatment on the content of hemicellulose

The average content of hemicellulose in the fermented peel of coffee with various levels of probiotics and the different fermenting durations can be seen in Table 4.

The result of the data analysis shows that there is interaction among the levels of probiotic and the duration of fermenting on the content of hemicellulose. Among the treatment given, there is an obvious different effect ( $P < 0.01$ ). Factor A (level of probiotic) and factor B (duration of fermenting) have the same sound, which is the elicited contrast different effect ( $P > 0.01$ ). The more duration taken to ferment, the less the content of hemicellulose got. The data got in this study support the sulaiman's finding that is duration of fermentation can give effect on the content of hemicellulose. Hartono in Mirnawati, 2007 said that *A. niger* produces cellulose beside other enzymes, those are amylase, protease, glucoamillase, lactase, catalase, glucose oxidase, lipase, hemicellulose and pectinases.

### 3.5 The effect of treatment on the content of lignin

The average of content of lignin in the fermented peel of coffee with various levels of probiotic and the different fermenting durations can be seen in Table 5.

The result of data analysis shows the interaction among the levels of probiotic and the duration of fermenting of the content of lignin. The higher the level of probiotic, the more time taken to ferment and the more the content of lignin obtained in the fermented peel of coffee. The class of lactate acid in probiotic *Laktobacilusa cidophyllus* can decrease the substrate pH up to the level of acid. The score of pH obtained in this study is 4 in average (acid). Thus the more doses of microbe and the more population of microbe *Laktobacilusacidophyllus* as well, the more acid thus the more lignin should be torn apart. This data supports (Nofriadi, 2009) the fact that lignin can be soluble in enough acid condition. In addition, it agrees with studies (Rasjid, 2009) that the fermentation process with bacteria of lactate acid (*Lactobacillus sp*) significantly influences ( $P < 0.01$ ) the decrease in lignin. This occurs because lignin is soluble in acid pH.

**Table 4.**  
The Effect of  
Treatment on  
Hemicellulose

| Level of Probiotic (%) | Duration of Fermentation (Days) |                    |                    | Mean               |
|------------------------|---------------------------------|--------------------|--------------------|--------------------|
|                        | B1                              | B2                 | B3                 |                    |
| A1 2.5%                | 35.05                           | 33.72              | 34.29              | 34.35 <sup>a</sup> |
| A2 5%                  | 32.46                           | 31.88              | 28.78              | 31.04 <sup>b</sup> |
| A3 7.5%                | 38.23                           | 34.41              | 33.71              | 35.45 <sup>c</sup> |
| Mean                   | 35.25 <sup>a</sup>              | 33.34 <sup>b</sup> | 32.26 <sup>c</sup> |                    |

<sup>a,b,c</sup>Mean with different superscripts show contrast different effect ( $P > 0.01$ ).

**Table 5.**  
The Effect of  
Treatment on Lignin

| Level of Probiotic (%) | Duration of Fermentation (Days) |         |         | Mean               |
|------------------------|---------------------------------|---------|---------|--------------------|
|                        | B1 = 20                         | B2 = 30 | B3 = 40 |                    |
| A1 2.5%                | 22.55                           | 21.02   | 20.75   | 21.45 <sup>a</sup> |
| A2 5%                  | 16.90                           | 20.65   | 19.64   | 19.06 <sup>b</sup> |
| A3 7.5%                | 17.93                           | 16.46   | 17.20   | 17.20 <sup>c</sup> |
| Mean                   | 19.13                           | 19.38   | 19.19   |                    |

<sup>a,b,c</sup>Mean with different superscripts show contrast different effect ( $P > 0.01$ ).

## 4. Conclusion and suggestion

### 4.1 Conclusion

The result of the study shows that addition of probiotic can decrease the content of crude fiber in the peel of coffee as much as 27.66% of total peel of coffee; 3.6% of NDF decreases. Moreover the content of ADF decreases up to 4.10%. Hemisellulosa decreases up to 10.34%. In addition, 18.48% of cellulose decreases and 18.75% of lignin gives the same result. The best result is got for number A3B3 with 7% probiotic, and the duration of fermenting takes 30 days. The amount of crude fiber got at Gayo highland is high enough which is 40%; after fermenting it decreases to 34% so that PAC is categorized in the wool as the source of fiber. Thus the waste of PAC Arabica coffee can be used as the alternative green wool for the ruminansia livestock.

### 4.2 Suggestion

In the process of fermentation, it is suggested that water be added to the dust of the husk and some of the urea on the substrate, which is hoped will loosen the bound of lignocellulose so that the level of digest increases. If needed some more population digesting mildew of crude fiber such as *T. viride* and *A. niger* or any other kind of digesting microbe be added.

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