

**The Effect of Fermentation on The Nutrients of Processed Cowpea
(*Vigna unguiculata* l. Walp)**

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ABSTRACT

Cowpea is a type of legume in Indonesia but utilization not optimal. Cowpea can be used as a basic of making tempeh. The purpose of the study is to know the effect of fermentation on the nutrients of processed cowpea. The design of the study was Pra Eks/imen Design with Completely Randomized Design in laboratory to test nutrients which were repeated 3 times. Data analysis used SPSS (Statistical Product Service Solution) application. The measurement of carbohydrate used anthron method, crude fiber used refluks method, total protein used kjeldhal method, and fat used soxhlet method. Nutrients of boiled cowpea is carbohydrate content of 31,21%; crude fiber content of 13,94%; total protein content of 26,71% and fat content of 7,35%. Nutrients of cowpea tempeh is carbohydrate content of 26,71%; crude fiber content 17,21%; total protein content of 15,38% and fat content of 1,44%. There are not statistical different nutrients of boiled cowpea and tempeh cowpea, but different values.

Keywords: *Fermentation, Nutrients, Cowpea*

INTRODUCTION

Cowpea including of protein that has long been grown in Indonesia, easy to cultivated, high protein and relatively more affordable prices compared with soybeans but rarely used as a commercial product so it not cultivated intensively. Cowpea having complex nutrition. It been which one type of local legume source protein have a great opportunity to satisfy needs of protein from soybeans. According to BPS 2019 th, the total imports of soybeans in Indonesia reached 2,67 million ton, while soybeans not only used as a basic ingredient in making *tempeh*, but some food products use it as the basic material for the maked. So need for the development of basic ingredient in making *tempeh* utilizing cowpea.

Cowpea until now only used as a mixture in several traditional foods of Indonesia such us lepet or used as the mix on vegetable processed. The use of cowpea as a food vegetable protein source is still lacking in the community. From a sosio-economic, consumption of vegetable protein will be cheap and easy reach of the community compared animal protein that to be more expensive. The processing of fermentation to be *tempeh* includes a boiling process and a fermentation process. Boiling treatment in the *tempeh* fermentation process can affect the result value of the nutrient. The nutritional value of food can also be affected by differences in the processing of food. Processing by fermentation of processed cowpea to be cowpea *tempeh* expected to be an alternative of soybean *tempeh* which can be

used as source of vegetable protein which is cheap and easily to get in the community. So, this study aims to determine the effect of fermentation on the nutrients of processed cowpea.

MATERIALS AND METHODS

The characteristics of cowpea in this research is nutbrown, square shape and the length of seed is 0,7-0,9 mm (Balitkabi, 2019). Making boiled cowpea includes sorting steps, soaking for 6 hours, draining and clean using water flowing, boiling for 5 minutes added when the water has boiled, drain and separate of cowpea. While making *tempeh* cowpea is a modification of Pagarra (2011) and Dewi (2010) research including sorting steps, soaking for 6 hours, draining and use clean waer flowing, boiling for 5 minutes added when the water has boiled, drain and separate of cowpea, clean using water flowing, steam for 20 minutes added after the water is boiling, drain and wait until cold, mixed cowpea with yeast 0,2 gram/100 gram cowpea, wrap the cowpea has been mixed with use teak leaves as much as 50 gram/pack and fermented for 36 hours.

Nutrition analysis

This research is Pra Eks/imen Design with Completely Randomizes Design which were repeated 3 times. The matherials in this research is boiled cowpea and *tempeh* cowpea made in Food Laboratory of Ngudi Waluyo University and the nutrition analysis test was conducted at the Chemistry Laboratory Faculty of

Science and Mathematics Satya Wacana Christian University (UKSW) Salatiga in August 2020. The measurement of carbohydrate used anthron method, crude fiber used refluks method, total protein used kjheldal method and fat used soxhlet.

Statistical analysis

Data analysis used SPSS (*Statistical Product Service Solution*) application for Windows Release 16.0., the *Kruskal Wallis* test used to knows the different nutrients of boiled cowpea and *tempeh* cowpea.

RESULTS AND DISCUSSION

Overview research object

Boiled cowpea that are processed cowpea with boiling use water as the boiling medium. While cowpea *tempeh* is made from cowpea as a basic ingredients, then added the yeast and mixed until evenly, the cowpea have been mixed with yeast are then weighed as much as 50 grams in a pack cowpea *tempeh* and fermented for 36 hours.

Preliminary studies in cowpea *tempeh* doing by observing the fermentation results of cowpea *tempeh* made by using plastic wrap/s, banana leaf and teak leaves, the observations including of color, texture and aroma. Characteristic of cowpea *tempeh* based on table 1. the result of observations showed that cowpea *tempeh* with teak leaves wrapping type produces the best characteristics of *tempeh*. So this study using teak leaves as a wrap / in making cowpea *tempeh*.

Table 1. Characteristics of Cowpea *Tempeh*

| Cowpea <i>Tempeh</i> | Wrapping Type | Color | Texture | Aroma |
|----------------------|---------------|--------------|---------------|--------|
| | Plastic | Brownish | Not solid | Rotten |
| Banana | White | Rather solid | Rather rotten | |

| | | | | |
|-------------|-------|-------|---------------------------------|--|
| leaf | | | | |
| Teak leaves | White | Solid | Typical of cowpea <i>tempeh</i> | |

Nutrients of boiled cowpea

The nutrients of boiled cowpea can be seen in Table 2. it's known that the highest nutrient content in

100 grams of boiled cowpea is carbohydrates of 31,21±4,61. While the lowest nutrient content is fats of 7,35±6,89.

Table 2. Nutrients of Boiled Cowpea

| Zat Gizi | Kacang Tolo Rebus / 100 gram | | | |
|-----------------------|------------------------------|--------------|--------------|-------------------|
| | Repeat 1 (%) | Repeat 2 (%) | Repeat 3 (%) | Average (Mean±SD) |
| Carbohydrate content | 36,34 | 29,91 | 27,38 | 31,21±4,61 |
| Crude fiber content | 18,27 | 14,71 | 8,83 | 13,94±4,77 |
| Total protein content | 11,45 | 12,63 | 13,42 | 12,50±0,99 |
| Fat content | 3,38 | 15,30 | 3,36 | 7,35±6,89 |

The process of soaking cowpea for 6 hours will be the weight of cowpea being 2 times heavier than the raw cowpea or the cowpea before soaking process. At 100 grams of raw cowpea will have weight to be 200 grams of cowpea after soaking during 6 hours. After the boiling process the cowpea will have a lower weight but not significantly different, only lower by reduce their weight 2 to 3 grams.

The step after boiling is separating the cowpea with the skin takes time for 2 hours so obtained cowpea ready for analysed the nutrition which includes carbohydrate content, crude fiber content, total protein content and fat content. Analysis of nutrient was repeated of 3 times for each nutrient content and the average nutritional content of boiled cowpea was obtained.

The crude fiber and at / 100 grams of boiled cowpea was higher, the fiber content of 13,94% and the fat content of 7,35% compared to the crude fiber and the fat contents / 100 grams of raw cowpea, the crude fiber

content of 1,69% and the fat content of 1,99% (Indonesian Food Composition Table, 2018). The fiber content and fat content in this study are different from the research of EC Omenna (2016) that cowpeas boiled with tem/ature 100°C for 65 minutes have a crude fiber content of 1,81% and fat content of 3,56%. Consumption of boiled cowpea as much as 100 grams can provided 56% of fiber needs / day based on WHO as much as 20-30 grams.

The daily fat requirement based on the 2019 RDA for adult males aged 19-29 years is 75 grams and adult women aged 19-29 years is 65 grams. Consuming of 100 grams of boiled cowpeas, it can provide 9,8% of fat needs in adult men aged 19-29 years and 11,3% in adult women aged 19-29 years. The carbohydrate and protein contents / 100 grams of boiled cowpea was lower, the carbohydrate content of 24,4% and the protein content of 12,5% compared to the carbohydrate and protein contents / 100 grams of raw cowpea, the carbohydrate content of 56,69% and the protein

content of 31,21% (Indonesian Food Composition Table, 2018).

Consuming 100 grams of boiled cowpea can provide 7,2% from 430 grams of carbohydrate needs in adult men aged 19-29 years (RDA, 2019) and 8,6% from 360 grams of carbohydrate needs in adult women aged 19-29 years (RDA, 2019). Meanwhile, consuming 100 grams of boiled cowpea can provide 19,2% from 65 grams of protein requirements for adult men aged 19-29 years (RDA, 2019) and of 20,8% from 60 grams of protein requirement for adult woman aged

19-29 years (RDA, 2019). The boiling process using heat causes protein denaturation so it the bonds between amino acids to cut off and the protein content to be lower with increasing boiling time (Pagarra, 2011).

Nutrients of cowpea *tempeh*

The nutrients of cowpea *tempeh* can be seen in Table 3. it's known that the highest nutrient content in 100 grams of cowpea *tempeh* is carbohydrates of 25,71±3,32. While the lowest nutrient content is fats of 1,44±1,32.

Table 3. Nutrients of Cowpea *Tempeh*

| Nutrients | Boiled Cowpea / 100 grams | | | |
|-----------------------|---------------------------|--------------|--------------|-------------------|
| | Repeat 1 (%) | Repeat 2 (%) | Repeat 3 (%) | Average (Mean±SD) |
| Carbohydrate content | 22,41 | 29,04 | 25,69 | 25,71±3,32 |
| Crude fiber content | 16,75 | 6,38 | 28,49 | 17,21±11,1 |
| Total protein content | 17,56 | 16,11 | 12,48 | 15,38±2,62 |
| Fat content | 2,93 | 0,43 | 0,97 | 1,44±1,32 |

Cowpea *tempeh* is made from cowpea which are then added with yeast in the production, wrapped in teal leaves and fermented 36 hours. In every step of the process of making cowpea *tempeh*, a washing process is always doing with water flowing which aims to remove any dirt that might adhere to cowpea after a series of processes in making cowpea *tempeh*.

The cowpea *tempeh* which has been fermented for 36 hours then analysed nutrition including carbohydrate content, crude fiber content, total protein content and fat content with 3 repetitions so that an average of each nutrition contents of cowpea *tempeh* is obtained. The weight of cowpea *tempeh* after fermentation will be change when

compared to the weight of cowpea *tempeh* before fermentation. In the process of making cowpea *tempeh*, each pack of *tempeh* weighs 50 grams. After being fermented for 36 hours, the weight of the cowpea *tempeh* will be reduced it's weight 2-3 grams each *tempeh*. One exchange or serving of cowpea *tempeh* is 50 grams.

The carbohydrate content of cowpea *tempeh* (25,71%) was lower than boiled cowpea (31,21%) / 100 grams. The lower contents of carbohydrate in cowpea *tempeh* are due to that during the fermentation process carbohydrates have been widely used for microbes or *tempeh* yeast as energy during the fermentation process (Dewi, 2010). One cowpea *tempeh* exchanger

which is 50 grams can provide the carbohydrate needs of 2,99% in adult men with carbohydrate needs from 430 grams (RDA, 2019) and provide carbohydrate needs of 3,57% in adult women with carbohydrate needs as much as 360 grams (RDA, 2019).

The crude fiber content of cowpea *tempeh* (17,21%) was higher than boiled cowpea (13,94%)/100 grams. The result of crude fiber content in this study were higher compared by Ratnaningsih et al (2009) research, which was 10,66% / 100 grams. During the fermentation process of cowpea *tempeh* there is a tendency to increase crude fiber content caused the degradation of polysaccharide components or complex carbohydrates into simpler components doing of enzymes produced fungus *tempeh* (Ratnaningsih et al, 2009). Consuming one exchange or one serving of cowpea *tempeh* which is 50 grams can provide 23,27% of the fiber needs for adult males aged 19-29 years with a daily fiber requirement of 37 grams (RDA, 2019) and provide 26,91% of the fiber needs for adult women aged 19-29 years with daily fiber needs are 32 grams (RDA, 2019).

Total protein content of cowpea *tempeh* (15,38%) was higher than boiled cowpea (12,5%) / 100 grams. The higher protein content of cowpea *tempeh* in this study is in line with the research of Ratnaningsih (2007) that the total protein content of cowpea *tempeh* changes during the fermentation process which can be seen in the results of different total protein content in cowpea *tempeh* on day 0, day 1 and day 2 with a significant difference at the 5% significant content and the

highest total protein content in fermented *tempeh* on day 2 (48 hours) which was 31,57% / 100 grams. The protein content of cowpea *tempeh* is lower of 0,62% compared to the protein content of soybean *tempeh* in SNI 3144:2009 was the protein content of soybean *tempeh* is at least 16%. The high protein content in cowpea *tempeh* can be used as an alternative food source of vegetable protein in vegan vegetarian diets. Consuming one cowpea *tempeh* exchanger can provide 11,83% of protein needs in adult males aged 19-29 years which is 65 grams (RDA, 2019) and provide 12,82% of protein needs in adult women aged 19-29 years of 60 grams (RDA, 2019).

The fat content pf cowpea *tempeh* (1,44%) was lower than boiled cowpea (7,35%) / 100 grams. The lower fat content in cowpea *tempeh* caused the activity of the lipase enzyme which depends on the length of fermentation time (Dewi, 2009). In addition, according to Deliani (2008) the decrease in fat is due to the fungus *Rhizopus oligosporus* which is lipolytic which can hydrolyze fat. Consuming one cowpea *tempeh* exchanger which is 50 grams can provide 0,96% of the fat needs in adult males aged 19-29 years with a daily fat requirement of 75 grams (RDA, 2019) and provide 1,11% of the fat needs of adult women aged 19-29 years with a daily fat requirement of 65 grams (RDA, 2019).

Different nutrients of boiled cowpea and tempeh cowpea

In Table 4. the result of *Kruskal Wallis* test knowed that not different nutrients of boiled cowpea and cowpea *tempeh* it's showed by p

value $p > 0,05$ for each nutrient contents. However, if it's seen in Table 5. based on of each nutrient contents showed that are different

values of each nutrients contents of boiled cowpea and cowpea *tempeh* according to the type of processing.

Table 4. Different Nutrients of Boiled Cowpea and Cowpea *Tempeh*

| Nutrients | Boiled Cowpea / 100 grams (Mean±SD) | Cowpea <i>Tempeh</i> / 100 grams (Mean±SD) | p |
|-----------------------|---|--|-------|
| Carbohydrate content | 31,21±4,61 | 25,71±3,32 | 0,127 |
| Crude fiber content | 13,94±4,77 | 17,21±11,1 | 0,827 |
| Total protein content | 12,50±0,99 | 15,38±2,62 | 0,275 |
| Fat content | 7,35±6,89 | 1,44±1,32 | 0,050 |

Table 5. Nutrients of Processed Cowpea

| Nutrients | Raw Cowpea (Indonesian Food Composition Table, 2018) (%) | Boiled Cowpea (%) | Cowpea <i>Tempeh</i> (%) |
|-----------------------|---|----------------------|--------------------------------|
| Carbohydrate content | 56,6 | 31,21 | 25,71 |
| Crude fiber content | 1,6 | 13,94 | 17,21 |
| Total protein content | 24,4 | 12,50 | 15,38 |
| Fat content | 1,9 | 7,35 | 1,44 |

Nutrients analysis of boiled cowpea and cowpea *tempeh* which was tested using the *Kruskal Wallis* statistical test showed that are not different nutrients of boiled cowpea and cowpea *tempeh* as evidenced by the p value of each nutrients $p > 0,05$ includes carbohydrate content ($p=0,127$), crude fiber content ($p=0,827$), total protein content ($p=0,275$) and fat content ($p=0,50$). However, the differences in fermentation treatment of cowpea did not caused statistically significant differences in the nutritional contents of boiled cowpea and cowpea *tempeh* but had differences in values.

The carbohydrate content in raw cowpea, boiled cowpea and cowpea *tempeh* has a difference, where is along the many processing caused it to be lower, the fiber

content becomes higher, the protein content becomes lower after boiling processed but the protein content of cowpea after the boiling process and then given fermentation treatment the protein content is higher than after being given only the boiling process, while the fat content becomes higher after being given boiling treatment and lower after being fermentation treated.

CONCLUSION

The result showed that the nutrients of boiled cowpea is carbohydrate content of 31,21%, crude fiber content of 13.94%; total protein content of 12,50% and fat content of 7,35%. Nutrients of cowpea *tempeh* is carbohydrate content 25,71%; crude fiber content is 17,21%; total protein content of

15,38% and fat content of 1,44%. And based on analysis bivariat showed that there are no statistical different nutrients of boiled cowpea and *tempeh* cowpea, but different values.

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