The Effect of Nutrient Addition to The Quality of Nata de Soya as Raw Material for Making Handicraft

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Abstract

The purpose of this study is to utilize waste from tofu production industry in order to reduce waste disposal to the environment. The study also aimed to observe the correlation between addition of nitrogen nutrient to wet weight, thickness, moisture content, and dry weight of Nata de Soya products. Waste was treated by fermentation method with variation of nitrogen concentration. The best result was obtained from the nitrogen concentration 0.4 grams which resulted in 5.2 grams dry weight of Nata de Soya and 86% moisture content.
Keyword : nata de soya, tofu, waste

1. Introduction

Tofu is a food prepared by concentrating soy protein and pressing the curds into soft white blocks. Tofu is widely consumed in Indonesia as a side dish that contains high protein. In addition, tofu is also a substitute protein source for people who do not consume animal products. Besides containing good nutrition, tofu production is also relatively cheap and simple, the product tastes good and the price is affordable by all levels of society.

Currently, the tofu industry is commonly found in Bekasi, West Java, Indonesia. The high demand in tofu production has expanded tofu industry in Bekasi. Tofu production in general still uses wood-fueled stoves. The production process uses hot extraction process, soy bean is cooked, coagulated, and filtered out to separate solid from liquid. A problem that often arises in the traditional tofu industry is the improper waste treatment. Liquid waste from tofu factories is usually disposed directly to the nearest ditch or river, without proper treatment. This will cause unpleasant smell, water pollution, and destruction of the environment (Mutiara et al., 2021). Industrial waste disposal to water bodies will cause decreasing water quality and harm human health (Putri & Fatimah, 2021). Tofu industry usually generated string and unpleasant odor. Waste treatment in tofu industry is required to reduce the risk of environmental pollution.

Utilization of tofu waste into food products is an alternative solution to environmental pollution problems (Andra Tamimi, Sumardi HS., 2015). Tofu processing liquid waste known as *whey* is usually reused in tofu coagulation but in very small amounts. The amount of *whey* which is disposed of is much greater so that it pollutes the environment. W*hey* still contains important nutrients, namely 1% solid material, 59% uncoagulated soy milk protein, 9% soy protein, amino acids, B vitamins, calcium , a number of glucose, fat and carbohydrates with a degree of acidity 4-5 (Sarkono et al., 2018). *Whey*, which contains high levels of protein and amino acids, can be used as a basic ingredient for making *nata* with the help of *Acetobacter Xylinum* (Iryandi et al., 2014). Utilization of *whey* as a raw material for making *nata* is more potential considering the large amount of *whey* produced in tofu production and its continuity. *Nata* is formed by

acetic acid bacteria in aerobic condition. In liquid tofu waste media, *nata* layer can reach a thickness of few centimeters and has chewy, white, and soft characteristic. (Sarkono et al., 2018).

The production of *nata* usually uses vinegar to lower the pH level to suit the optimal conditions for *Acetobacter Xylinum* bacterial growth. However,the addition of vinegar causes an unpleasant sour aroma so it requires further *nata* post-harvesting, usually by soaking and boiling repeatedly (Iryandi et al., 2014).

This study aims to utilize waste from tofu production industry in order to reduce waste disposal to the environment. the correlation between *nata de soya* weight, thickness, water content to dry *nata de soya* products are also observed.

This study uses lime as acid in making *nata de soya* instead of vinegar. Lime has the highest citric acid content among other oranges, i.e. 7%. Lime juice has an acidic character and a distinctive aroma, so it is hoped that the resulted *nata* will have more distinctive aroma with more practical post-harvest handling. (Iryandi et al., 2014).

NPK fertilizer is added as nitrogen source, which is required by *Acetobacter Xylinum* to carry out cell metabolism. The adequacy of the compounds for metabolic process shall be ensured to provide energy and components for cell growth. Good cell growth will result in enhancement of nata cellulose layer formation (Wardani, 2018).

The production of nata de soya can be used as an alternative for handling tofu liquid waste (whey), which currently is still neglected (Iryandi et al., 2014). It can also become source of income for the community in the vicinity of tofu production industries (Pratika Viogenta 1*, Amalia Khairunnisa2, 2022).

2. Literature Review

A study conducted by (Marliyana et al., 2021) on "Tofu Waste Processing into Nata de Soya by Fermentation" used *Acetobacter Xylinum,* with acetic acid and ZA foodgrade addition. Tofu liquid waste fermentation produced nata de soya in the form of gel, has white color, 2 mm thickness, moisture content 79.31%, and density 0.85. In this study, waste processing has modified tofu liquid waste into nata de soya. This is also one of the methods to reduce environmental pollution and increase economical value of tofu waste.

Another study was performed by (Iryandi et al., 2014) on "The Effect of Lime Juice (Citrus aurantifolia) Addition and Fermentation Duration to The Characteristic of Nata de Soya". The research method used was a completely randomized design arranged in a factorial (CRD-factorial) with two treatment factors. The first factor is the percentage of lime juice (N) which consists of three levels (1%, 2.5%, 5%) and the second factor is the length of fermentation (T) which consists of three levels (12 days, 14 days, 16 days). This study result revealed that the thickness of *nata* ranged from 0.5 cm to 1.9 cm, the yield ranged from 8.7% to 45.1%, the texture ranged from 3.1 N to 14.2 N, the insoluble fiber ranged from 0.55% to 1.53%, water content ranges from 98.75% - 99.35%, aroma ranges from 3.6 (neutral) to 4.5 (slightly like) and taste ranges from 3 to 3.25 (dislikes). The best result of this study was obtained at a concentration of 1% lime juice and 16 days of fermentation. Lime juice has a relatively lower pH than vinegar, where the lower the pH of the fermentation medium, the lower the insoluble fiber formed.

A study regarding production of nata de soya with the aid of *Acetobacter xylinum* and amendment of vinegar and NPK fertilizer was conducted by (Wardani, 2018). The produced nata would be dried and made into handicrafts material. Fermentation was prepared with the following variation of nutrition:

- C1N1 : Sugar 15% + NPK 0.3%
- C1N2 : Sugar 15% + NPK 0.5%
- C1N3 : Sugar 15% + NPK 0.7%
- C2N1 : 30% sugar + 0.3% NPK

- C2N2 : 30% sugar + 0.5% NPK
- C2N3 : 30% sugar + 0.7% NPK

The results of this study indicated variation of NPK fertilizer did not give significant difference of *nata de soya* thickness. Variation of sugar concentration caused significant thickness of nata de soya. With the addition of 15% sugar, nata de soya was formed perfectly with 1 cm thickness. Higher sugar concentration (30%) did not give optimum result, nata de soya thickness was less than 0.1 cm. In the experiment, it was found that the optimum thickness of *nata* was 1.13 cm, obtained from C1N1 with the addition of 15% sugar and 0.3% NPK.

Based on the previous references, an experiment was prepared by changing the variation of the material used in the production of *nata de soya*. Raw material used was liquid tofu waste (whey), lime was used as the source of acid, and fermentation was carried out by *Acetobacter xylinum*. The produced nata de soya will be made into handicraft, i.e. wallets. It is expected that this experiment will give alternative to utilize liquid tofu waste, instead of disposing it directly to the environment and cause pollution. The production of nata de soya also gives economic valued if it is properly handled.

3. Research Method

3.1. Research Approach

This study generally uses a quantitative approach. Most of the data obtained are in the form of measured variables. This study analyzes the thickness, weight, and water content of nata which affect the quality of nata de soya for making handicrafts.

3.2. Types of Research Data

The type of data used is primary data, which is obtained directly from measurement of thickness, weight, and water content in nata after harvesting.

3.3. Research Data Sources

Data is obtained through direct observation. The object of study is examined, recorded, and all related condition is documented.

3.4. Research Instruments

Experimental variables, materials, tools, work steps, and work charts are described as follows:

a. Variables

The variables used in this study are divided into 3 independent variables, dependent variables and control variables. The independent variable is variation of nitrogen addition. The nitrogen source is NPK. The weight of NPK is varied between 0.4 grams, 0.5grams, 0.6 grams, and 0.7 grams. The dependent variables are weight, thickness, and water content of nata. The control variables are tofu liquid waste substrate, sugar, and lime juice concentration.

b. Materials Used

- NPK with weight variations of 0.4 grams, 0.5 grams, 0.6 grams, and 0.7 grams,
- 61 gram sugar
- 2 ml lime juice
- Acetobacter xylinum starter (10% of substrate)

- 500 ml liquid tofu waste. The waste was obtained from Tofu Industry 57 on Jalan Kramat Mundu Barat, Mangunjaya Village, South Tambun District, Bekasi Regency, West Java, Indonesia.

c. Tools
- pans for cooking liquid tofu liquid
- scales for weighing sugar and NPK,
- plastic containers for incubation
- spoons for taking ingredients
- stoves for heating waste
- newspapers to cover plastic containers during incubation
- knife
- rubber bands to bind newspapers in plastic containers
- 500 ml measuring cup to measure the substrate
- filter cloth to filter whey
- iron rack to place plastic containers during incubation,
- gallon to contain liquid tofu waste,
- pH meter to measure the pH of acid sources
- 2 ml measuring spoons for adding bacterial starter and lime juice.
- mortar to press wet nata
- plastic to put wet nata
- trays for drying wet nata

d. Work Procedures

The work steps in this research are as follows:

- Prepare materials and tools to be used
- Squeeze the lime to get the juice, then measure the pH.
- Pour the liquid tofu waste (substrate) by pre-filtering it into the pot, adding about 150 ml more than the amount of substrate to be used, so the substrate volume is 650ml. The substrate is then heated for about 10 minutes, make sure the substrate is boiled, after that turn off the heat.
- The substrate is poured and filtered into a 500 ml measuring cup. after Add 61 grams of sugar to 500 ml of substrate. NPK is then added with variation of 0.4 grams, 0.5 grams, 0.6 grams, and 0.7 grams, respectively. Stir the mixture until smooth
- Add 2 ml of lime juice to the substrate
- Pour the mixture into a plastic container and cover it with newspaper and tie it with a rubber band. Wait for the mixture to come to room temperature.
- Add 5 ml Acetobacter xylinum starter, distribute the starter from 4 ends of the container
- Incubate for 14 days, after that nata is ready to be harvested.
- Harvest the nata, wash the nata to clean and remove the smell. Squeeze nata by using filter paper
- Put nata into plastic bag and press it by using stone mortar
- Dry the nata in the sun
- The dried Nata is then shaped into a small wallet with a satin cloth inside, and add a zipper. The wallet is ready.

e. Flow Work Chart

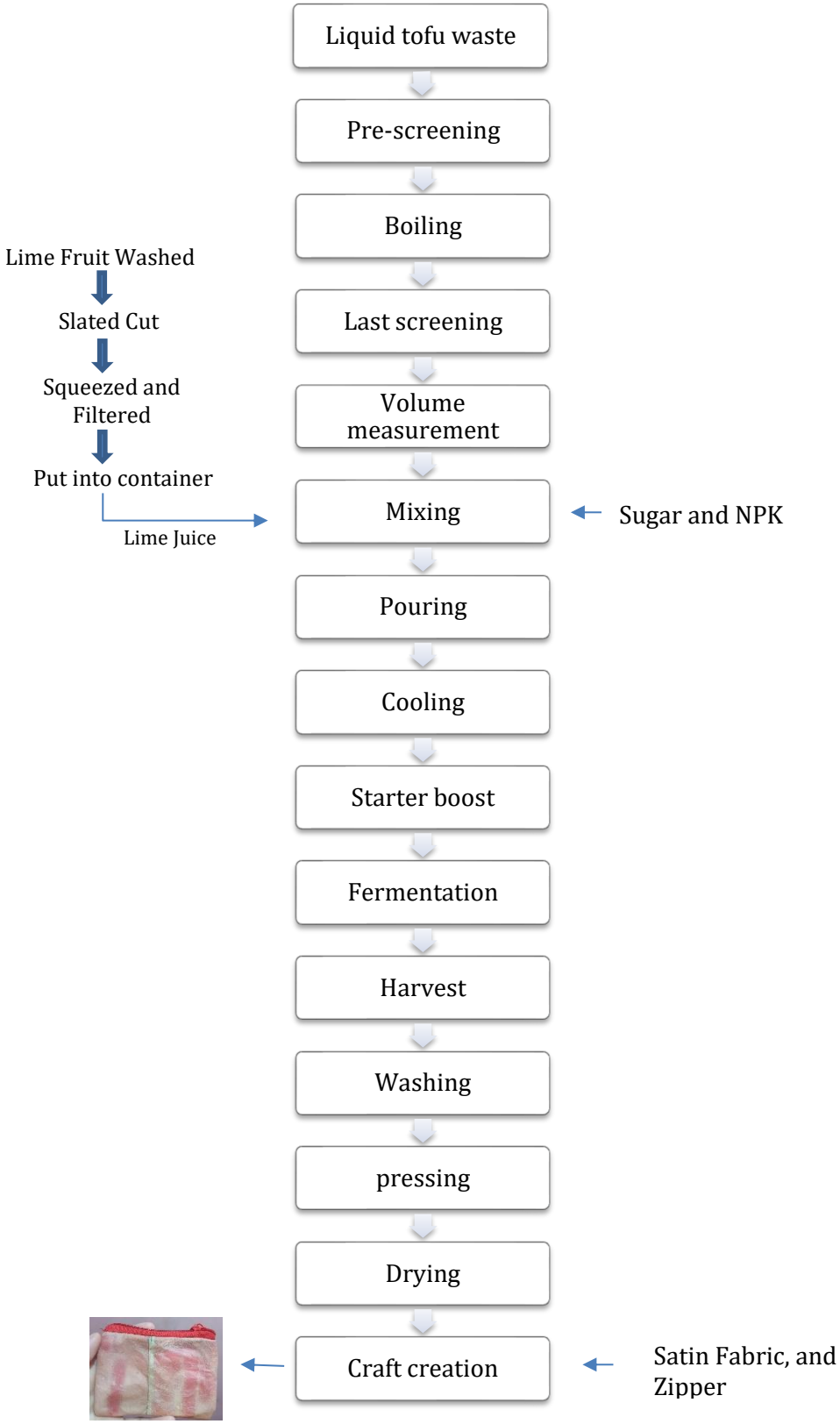

Figure 1. Liquid Tofu Waste Processing into Handicraft

3.5. Data Analysis Techniques

Analyses method for this study is quantitative analysis. Liquid tofu waste will be processed into nata de soya, which can be used to make handicraft. Correlation between NPK variation and the weight, thickness, and moisture content of nata de soya. Data is evaluated by using simple statistics in the form of graphs and described descriptively.

4. Result

4.1 Wet Nata Thickness

Thickness of nata de soya is obtained by measuring it by ruler. Thickness of nata de soya for each variation is described in Figure 2.

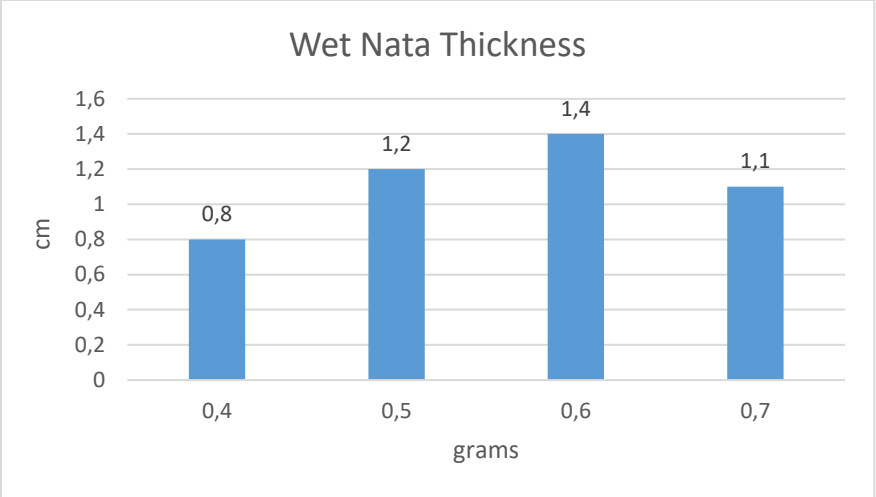

Figure 2. Wet Nata Thickness Chart

The data shows that the best thickness of wet nata is the variation of NPK 0.6 grams with a thickness of 1.4 cm and the lowest thickness is NPK 0.4 grams with a thickness of 0.8 cm. Based on the above data, it can be concluded that the optimum level of *Acetobacter xylinum* bacterial growth is in the variation of 0.6 grams NPK. Bacterial growth is affected by several condition, i.e. pH, media used, dissolved oxygen, and also carbon sources (Putri & Fatimah, 2021).

4.2 Wet Nata Weight

Wet nata weight in each variation is summarized in figure 3. Addition of 0.6 gram NPK gave the best wet nata weight result, i.e. 44 gram, while addition of 0.4 gram NPK resulted in 37 gram wet nata weight. The weight of the nata is directly proportional to the thickness of the nata. The thicker the nata, the heavier the nata weight (Novia et al., 2021). This is also because the availability of nutrients is proportional to the number of bacterial inoculums so as to produce nata with the maximum thickness. Addition of 0.7 gram NPK resulted in decreasing wet nata weight, i.e. 40 gram. It is not recommended to add excessive NPK because it can cause an imbalance of nutrients in the media which is not good for bacterial activity and decreasing nata quality.

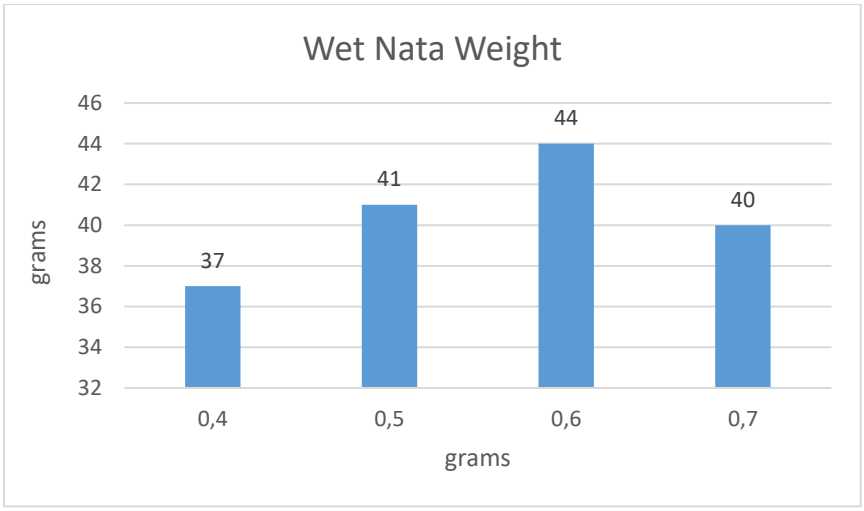

Figure 3. Wet Nata Weight Chart

4.3 Nata Moisture Content

Moisture content is determined by using the gravimetric method. The result for each variation is described in figure 4.

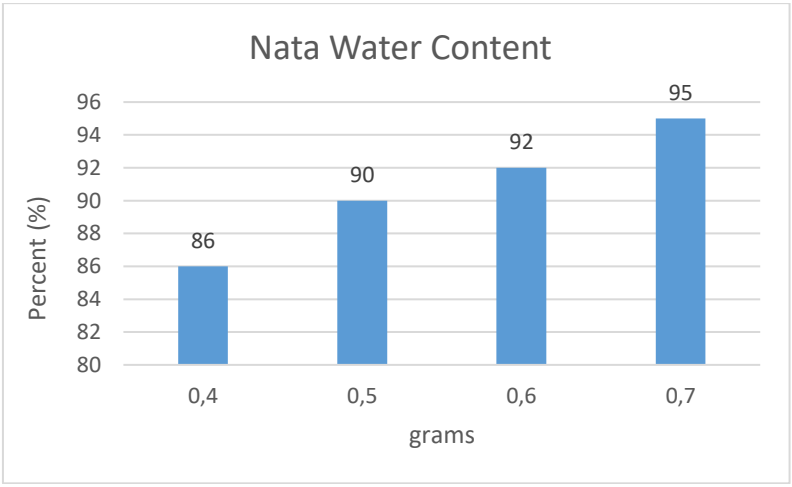

Figure 4. Nata Water Content Chart

Most of the components in nata are water because this food product is made in liquid medium. The less strong bonds between cellulose so that it binds more water which is bound when the nata pellicle is formed (Andra Tamimi, Sumardi HS., 2015). Based on the Figure 4, it is indicated that the highest moisture content is 95% and the lowest moisture content is 86%. When the level of water trapped in large quantity is low, the water content in nata de soya will be high. (Putri & Fatimah, 2021). The higher NPK concentration is added, the higher moisture content in nata de soya. This happens because the thick nata de soya has weaker cellulose bond so it absorbs more water. Meanwhile, the thin nata de soya has stronger cellulose bond so it absorbs less water (Urbaninggar & Fatimah, 2021).

4.4 Dry Nata Weight

Dry nata weight is analyzed by using the gravimetric method. The analysis result of dry nata weight is described in figure 5.

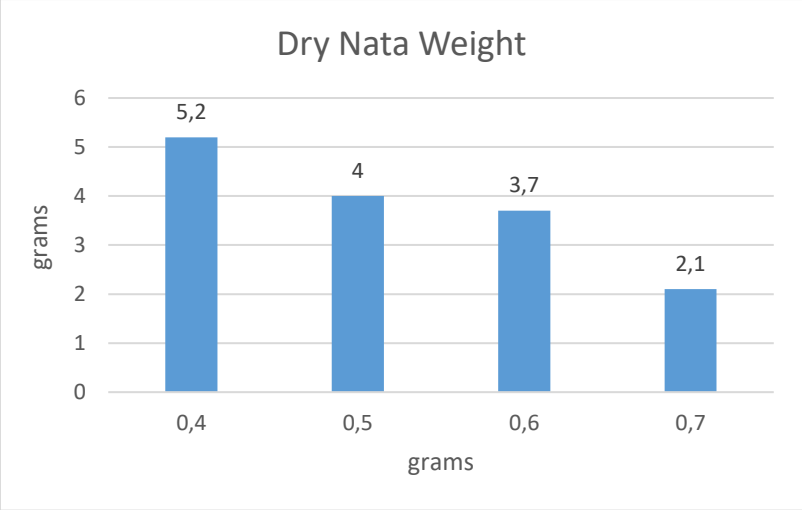

Figure 5. Dry Nata Weight Chart

Based on the data shown in Figure 5, the highest weight of dried nata is 5.2 gram, resulting from NPK variation of 0.4 gram. The lowest weight is 2,1gram, resulting from NPK variation 0.7 gram. Higher NPK concentration resulted in lower dry nata weight. It can be concluded that lower concentration of NPK resulted in heavier dry nata because it contains less water.

4.5 Raw Material for Handicrafts

Dry nata de soya can be used for raw material for making handicrafts. In this study, dry nata de soya is modified into pouch by sewing nata with satin cloth. The product from dry nata is shown in figure 6.

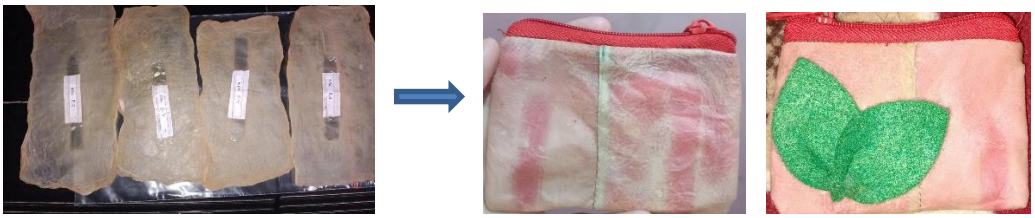

Figure 6. Handicrafts from Dried Nata

Form figure 6, it can be seen that the texture of dry nata is almost similar to leather but it looks more transparent. Dry nata is flexible and not easily broken. It can also be made into bag or wallet.

5. Discussion

Liquid tofu waste can be processed into nata de soya, which can be raw material for making handicrafts. Utilization of liquid tofu waste can reduce the disposal of waste and modify waste into valuable things. It is expected that this treatment can be applied by the community around the tofu factory so that the liquid waste will not pollute the environment.

6. Conclusion

The variation of NPK concentration in this is study is 0.4 grams, 0.5grams, 0.6grams, and 0.7grams. From this study, it is indicated that the highest dry weight is obtained from NPK concentration 0.4 gram. As for the wet weight, thickness and moisture content of 0.4

grams NPK gives the lowest value. However, lower moisture content in nata de soya is better because the dry weight is heavier. It can be concluded that from 4 variation of NPK concentration, 0.4 gram of NPK gave the best result with 86% of moisture content and 5.2 gram of dry weight.

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