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Sensory Evaluation And Functional Compound of Moringa Dry Noodles

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Abstract:*Moringa (Moringanoleifera Lam) is a plant that contains a plenty of nutrients such as of mineral, protein, β-carotene, amino acid, vitamin C and vitamin E. The vitamins are sources of natural antioxidant. It is important to conduct fortification of moringa leaves in dry noodles to analyze their nutrients after being processed with water blanching and moringa leaves selection. The aim of this research was to reveal the influence of moringa leaves supplementation on sensory acceptance, dietary fiber, vitamin A and also antioxidant activity of dry noodles. The stem structure of moringa leaves used in this research was stem 1, 3 and 5 that started from the tip of the leaf. The method used was water blancing for 1, 2,3 and 4 minutes with temperature of 70^{o}C. The outcome of the research indicated that the best moringa dry noodles contain the highest amount of dietary fiber, vitamin A and antioxidant activity. The best moringa dry noodles were produced using stem 5 and 3-minute water blanching.*

Keywords: *Moringa, Noodle, Water Blanching*

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I. Introduction

Timor land which is situated in East Nusa Tenggara (NTT) – Indonesia has a characteristic of dry climate and mountainous landscape. It has a great variety of vegetation including MoringaOleifera which is known as '*Kelor'* in its local language. This special plant is used for several purposes such as magic protection, medication, vegetables and rituals. The moringa leaves have a round shape like an egg with a flat edge. The leaves are small but have several layers in one stem. The colour of the leaves is green and it becomes darker when they grow older. Research that has been conducted across the world proved that fresh moringa leaves contain high and various nutrients. In fact, the vitamin C in moringa leaves is 7 times higher than in lemons, the vitamin A in moringa leaves is 10 times higher than in carrots, the calcium in moringa leaves is 17 times higher than in milk, the protein in moringa leaves is 9 times higher than in milk, the calium in moringa leaves is 15 times higher than in bananas and the zinc in moringa leaves is 25 times higher than in spinach (Moyo*et al.*, 2001*).*

The moringa leaves also contain high concentration of phosphor, copper, α-tocopherol, riboflavin, nikotinat acid, folat acid, pyridoxine and β-carotene. Because of its rich nutrients, Sengev*et al* (2013) supplemented moringa leaves on loaf bread. In addition, the leaves contain some significance of 10 amino essential acids. These leaves ability to absorb and neutralize toxins in food has made it important to be developed as a main source of protein for local food (Gadzirayi*et al*., 2012). The anti microba compound was proven by Rockwood et al. (2013) as a traditional medicine in remote areas that cannot access modern medication.

A study conducted by Melesse*et al*. (2012) and reviewed by Adewumipada*et al*. (2016) uncovered that moringa leaves are fortification materials with high nutrients like in *Stiff dough* 'Amala', cereals, porridge, bread, biscuits and yogurt that have a function to improve nutrients in a product. Nevertheless, further research needs to be conducted to test the stability and absorption rate of the product. Moringa leaves are processed with blanching method. Blanching is a heat-treatment process called pasteurization that takes place for several minutes using water blanching or steam. Blanching process is a thermal process with temperature between 70 to 100^{o}C for 1 to 15 minutes (Fellows, 2017). The main purpose of blanching is to non-activate enzymes such as peroxidase and catalase. Although some of microba also died during the process, these two enzymes are the most resistant to heat (Chen *et al*., 2017). Other purposes are to clean the materials, reduce the number of microba, expel the gasses from plant tissues and weaken plant tissues so that it is easy to fill the materials in a container, to eliminate unwanted odour or flavour, to clean mucus in some kinds of vegetables, to enhance color and also to brighten green color of the vegetables (Martnez*et al*., 2013).

Heats, which are exposed to the food during blanching process, decrease the sensory quality and nutrients of the product. Blanching changes the cell food physically and metabolically that causes cells to die. Heats damage cytoplasm and other membranes by making them permeable and lose cell turgor. Water and solute transport in and out cells cause loss of nutrients. In addition, heats inhibit the activity of subcellular organ and its constituent to interact inside the cells. This weakens or looses excessive flavour of the food. The quality of the food does not change significantly too (Fellows, 2017).

The supplementation of moringa leaves on food products must not only consider the nutrients but also consumers demand on the product. This is important to make sure that the price and packaging can compete with other products that have been available in the market. Dry noodles are one of popular products with high durability and practicality. Dry noodles are categorized as unhealthy food because they are high in carbohydrates but low in protein, fiber, vitamin and mineral. Therefore, the supplementation of moringa leaves on dry noodles is expected to produce enriched noodle product and to diverse local products.

II. Method

2.1 Place and Time of Study

Moringa leaves were selected from four-month old trees planted in 200 m dpl of Kupang Regency, East Nusa Tenggara.

2.1.1 Water Blanching of Moringa Leaves

Water blanching was applied to fresh moringa leaves that are free from damage and aphid. Then, moringa leaves were sorted from the stems and cleaned with running water. The stages in water blanching are:

1. Moringa leaves were boiled with a temperature o 70^{o}C for some time (Imaizumi*et al.*, 2017),
2. Moringa leaves were drained for 1 minute,
3. Moringa leaves were cooled in ice cubes (the ratio of cube and water is 1:4) for 2 minutes to terminate the thermal process. Then, they were drained for 1 minute (Mehtaa*et al.*, 2017).

The further step was mashing the moringa leaves and weighing them from 20% of dry noodles ingredients.

2.1.2 Mixing Properties

The moringa dry noodles were made by mixing moringa leaves' porridge of 29% with high protein flour (CakraKembar by Bogasari), salt and water in a noodle maker (Re-Noodle RN 88 made in China) for 5 minutes. The dry noodles that had been shaped were steamed for 10 minutes under the temperature of 100^{o}C. Then, they were drained with the temperature of 60°C for 2 hours. The process was applied to three different moringa leaves structures (stem 1, 3, 5) for one to four minutes water blanching. This had to be repeated for three times to produce 36 units of sample.

2.1.3 Sensory Evaluation, Dietary Fiber, Vitamin A, and Antioxidant Activity

A completely randomnized design (CRD) was used in this research with two trials. The first trial used the moringa leaves from the tip (T), stem 1, 3 and 5 and the duration of water blanching (W) was for 1, 2, 3, and 4 minutes. The evaluation of the sample used 5-point hedonic scale sensory evaluation done by 25 semi-trained panellists. The scale was ranging from 1 to 5 where scale 1 means strongly dislike, scale 2 means dislike, scale 3 means normal, scale 4 means like, scale 5 means strongly like the color, aroma, texture and flavour (Shobha*et al*., 2015).

The chemical analysis covered an analysis of vitamin A (β carotene) level using spectrophotometry UV-VIS made by Shimadzu, type 1201 from Japan. Each gram of sample was inserted in Erlenmeyer 100 mL covered by aluminium foil. Then, 10 mL of KOH (Merck, USA) and 20 mL of chloroform (Merck, USA) were inserted and set for ± 15 minutes. Then, it was vortexed and set again for 15 minutes. After 30 minutes, it was vortexed and centrifuged for 3 minutes with 4200 rpm. After centrifuging, a supernatant was poured in measuring cup of 50 mL, then, chloroform was added to fill the cup. 0.5 mL of solvent extraction was poured in a test tube and 4.5 mL of methanol (Merck, USA) was added to fill the tube. The solvent was measured λ = 440 nm using spectrophotometry. The dietary fiber was tested using enzymatic-gravimetric measurement (AOAC, 2012), and the antioxidant activity determined using DPPH method (Yen and Cheng, 1995) by dissolving methanol on certain concentration. 1 mL of main solvent and 1 mL of 200 DPPH µM (Sigma Aldrich D9132 solvent were poured in test tube. Then, it was incubated in dark room for 30 minutes. 5 mL of the solvent was diluted up to 5 mL using methanol. Then, a blanck sample (1 ml DPPH solvent + 4 ml methanol) with wavelength of 517 Nm was made.

$$\text{Antioxidant activity (\%)} = \frac{\text{OD Blanck} - \text{OD Sample}}{\text{OD Blanck}} \times 100\ \%$$

2.1.4 Data Analysis

The dietary fiber, vitamin A, antioxidant activity and hedonic test in supplemented moringa dry noodles were statistically analysed using software SAS 9.1.3. Then,Duncan Multiple Range Test (DMRT) with 5% signifance level was used to compare a value of every test result and treatment, which all of tests and treatments were repeated for three times.

III. Result And Discussions

Sensory Evaluation

The average value of acceptability on the sample of moringa dry noodles based on stem structure and water blanching duration can bee seen in Figure 1.

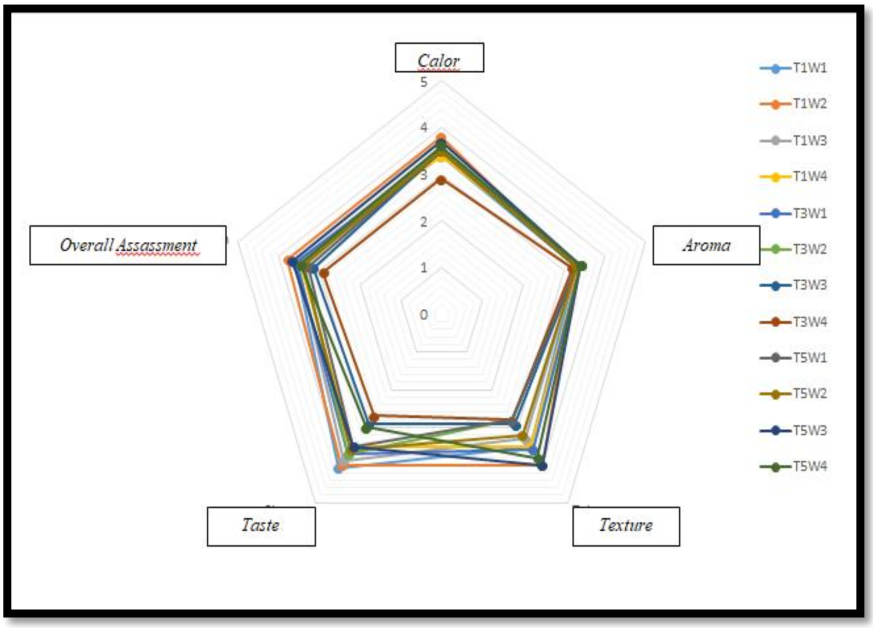

Figure 1. The interaction of each sensory attributes on sample of moringa dry noodles based on stem structure and water blanching duration

Note: Supplementation treatment of moringa leaves from different stem (1= T1, 3= T3, 5= T5); water blanching duration (1 minute = W1, 2 minutes = W2, 3 minutes = W3, 4 minutes = W4).

According to Figure 1, the analysis of multiple treatments based on stem structure and water blanching duration did not show significance difference on aroma but show significance difference on texture and colour parameters. While flavour parameter indicated significance difference. The highest acceptability score was found in stem 1 of supplemented moringa leaves with 2-minute duration of water blanching (T1W2) and stem 5 with 3-minute duration of water blanching (T5W3).

The sensory evaluation on colour, generally speaking, the panellists scored moringa dry noodles between neutral to like (3.0 – 3.8). This is because the green colour was still accepted although some panellists did not like it and gave low scores. The darker the moringa leaves color and the higher temperature exposed to the sample made the colour of the sample getting darker as well. The chlorophyll that used to be green turned out to be brown because of treatments during the process such as acid, thermal and browning enzymatic treatment (Widyadkk., 2012). This made consumers gave the highest score on texture parameter between 2-3 minutes, while; the score of aroma parameter did not indicate significance heterogenic score of the sample product.

Overall, the response of the panellists on moringa dry noodles differed for each treatment. This happened because moringa leaves from different stems need different water blanching duration. Young leaves need shorter time than old moringa leaves. Thermal process made the vegetable cell walls softer that facilitated protein digestibility. It was claimed by Muradoret *al*. (2016) that cooking process is positive because it soften the vegetable tissues and it facilitated extraction of bioactive compounds. Excessive temperature and cooking duration damaged texture and nutrients.

Dietary Fiber Level

The average value of dietary fiber level test of moringa dry noodles based on stem structures and water blanching duration can bee seen in Figure 2.

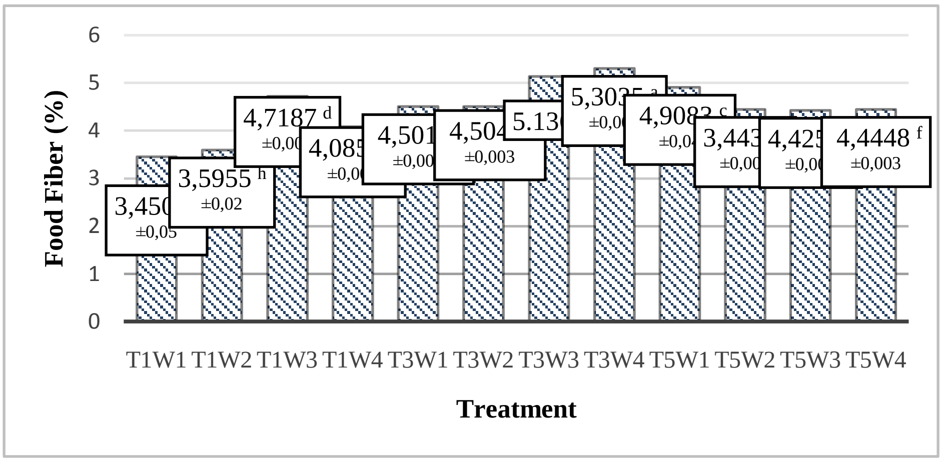

Figure 2. Bar chart of dietary fiber in moringa dry noodles based on stem structure and water blanching duration. The number in superscript font is same for each treatment factor that shows insignificance differences in Duncan Test with P=0.05.

Note: Supplementation treatment of moringa leaves from different stem (1= T1, 3= T3, 5= T5); water blanching duration (1 minute = W1, 2 minutes = W2, 3 minutes = W3, 4 minutes = W4).

According to Figure 2, this study indicated that the dietary fiber level of moringa dry noodles was between 3.4503 – 5.30355 %. The highest dietary fiber level was found in stem 3 of moringa trees. This is because the moringa leaves in stem 3 is the most active leaves that form tissues from cellulose. The proportion of dietary fiber components is varied among food products. One of the factors that contributes to this is cooking process. Oduntan and Olaleye (2012) claimed that cooking process in SesamumRadiatum S leaves indicated that young leaves contain significantly low dietary fiber. The base tissues in young leaves are still growing. Therefore, new cells will form pectin.

The cells are arranged by the bonds of cellulose strands that will form the primary and secondary walls. The cellulose in cell wall is pectin which is a polysaccharide that contains calcium and magnesium salts. The more cell walls formed in a young leave, the higher pectin level in it. Potential gel formation from pectin is reduced in plants that are too old or too ripe (Winarno, 2004). Demethylation which is an important process to form gel is taking place during ripening. However, over demethylation process will remove pectic acid that leads to failure to form gel.

According to the chart, water blanching process indicated insignificant influence. It also decreased dietary fiber level in longer water blanching duration. Palupi, *et al*., (2007) asserted that food processing does not change dietary fiber level significantly. However, Ilelaboye*et al*. (2013) claimed that blanching and cooking increase the soluble fiber content but insoluble fiber content decreases. Therefore, supplementation of moringa leaves is a source of dietary fiber in food products. Mallillin, *et al* (2014) studied moringa leaves in Manila and revealed that moringa leaves are the best source of dietary fiber. The fermentation of dietary fiber produces short-chain fatty acids (SCFA) with propionate as the highest SCFA. This is important because propionate has a key role to inhibit HMG-CoA Reductase activity in synthesising cholesterol.

Vitamin A Level

The average value of vitamin A level tests on moringa dry noodles based on the stem structures and water blanching duration can be seen in Figure 3.

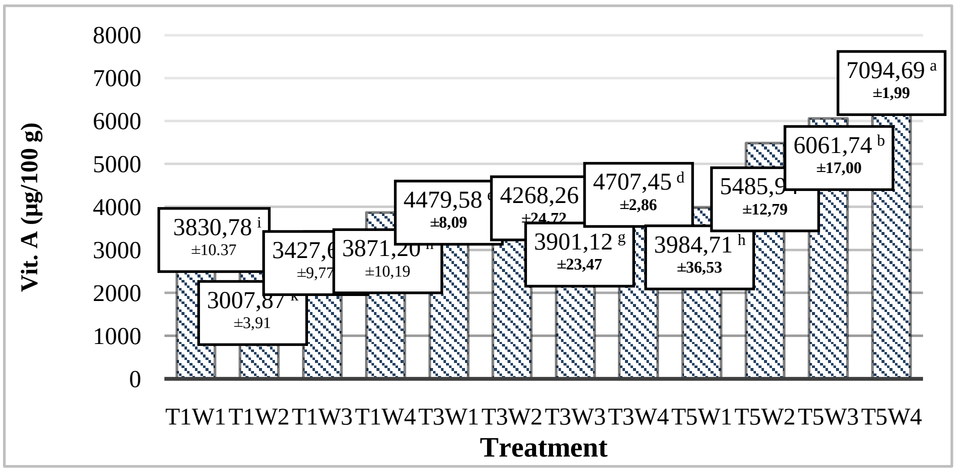

Figure 3.Bar chart of vitamin A level (microgram/100 g) in moringa dry noodles based on stem structures and water blanching duration. The numbers in superscript font is same for each treatment. It shows insignificance differences with Duncan Test of P=0.05.

Note: Supplementation treatment of moringa leaves from different stem (1= T1, 3= T3, 5= T5); water blanching duration (1 minute = W1, 2 minutes = W2, 3 minutes = W3, 4 minutes = W4).

Figure 3 shows that the vitamin A level in dry noodles was ranged between 3007,8735 – 7094,691 µg/100 mg. The research revealed that the level of vitamin A increased both in the treatments of old moringa leaves and water blanching. It was claimed by Asgar and Musaddad (2006) that the level of vitamin A in blanched-carrots was higher than unblanched carrots.

Antioxidant Activity

The average value of antioxidant activity test on moringa dry noodles based on stem structures and water blanching duration can be seen in Figure 4.

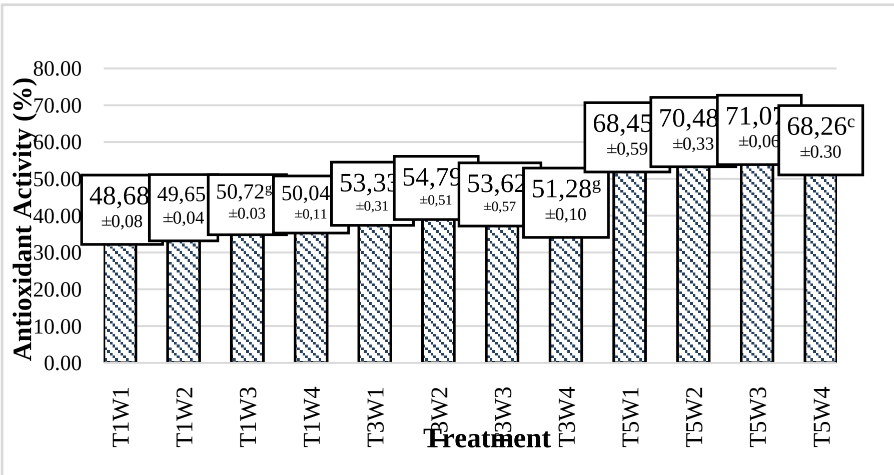

Figure 4. Bar chart of antioxidant activity (%) on moringa dry noodles based on stem structure an water blanching duration. The numbers in superscript font is same for each treatment. It shows insignificance differences with Duncan Test of P=0.05.

Note: Supplementation treatment of moringa leaves from different stem (1= T1, 3= T3, 5= T5); water blanching duration (1 minute = W1, 2 minutes = W2, 3 minutes = W3, 4 minutes = W4).

Figure 4 shows significance differences of water blanching durations and leaves from different stems. Water blanching tended to increase in second and third minutes and decreases on the following minutes. Murador*et al*., (2016) claimed that cooking process is positive because it can soften the vegetables tissues and facilitate extraction of some bioactive compounds such as antioxidant. The negative effect is cooking can reduce some of these compounds. According to Murador*et al.,* (2016), high antioxidant activity found in white and red cabbage after cooking was due to Maillard reaction. This happened because of long thermal process and storage duration that will lead to high antioxidant activity.

Some studies also revealed positive effects of cooking process. Some compounds might get damaged during the process that creates a variation of content and phenolic composition (Makris and Rossiter, 2001). Cooking condition such as time, temperature and methods will strongly influence antioxidant activity of vegetables.

Antioxidant activity in moringa leaves varied in each different stem where the highest antioxidant activity found in stem 5 of moringa trees. This was duet to total phenols and flavonoids content. Nouman*et al*. (2016) claimed that flavonoids compounds in moringa leaves are isorhamnetin, luteolin, rutin, quercetin and apigenin. Quercetin is a flavonoids compound that can catch free radicals and has high antioxidant activity (Es-Safi *et al*., 2007). Felicia (2016) claimed that high antioxidant levels found in old avocado leaves. Achakzai*et al*. (2009) claimed that old leaves contain higher phenols and flavonoids compounds than young leaves.

IV. Conclusions

The result of hedonic test revealed that the most favourite samples were moringa dry noodles using leaves from stem 1 and water blanching for 2 minutes, and also stem 5 and water blanching for 3 minutes. The highest dietary fiber, vitamin A and antioxidant level found in leaves from stem 5 with 3 minute-water blanching process. Water blanching duration depends on type of leaves. Further research is recommended to find out the formula with higher functional compounds that attracts more consumers.

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