

## Vitamin C content in yogurt with the addition of Tawangmangu tangerine juice (*Citrus nobilis* var. *Tawangmangu*)

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**Abstract.** Khasanah RN, Purwoko Tj, Susilowati A. 2015. Vitamin C content in yogurt with the addition of Tawangmangu tangerine juice (*Citrus nobilis* var. Tawangmangu). Nusantara Bioscience 7: 149-152. Yogurt is fermented milk that has an acid taste and known as probiotic food product that gives extra nutritional value. Most consumers like yogurt with fruit flavor added, one of them is orange. Tawangmangu tangerine (*Citrus nobilis* Lour. var. *Tawangmangu*) is one of local high-quality oranges come from Tawangmangu area, Karanganyar District, Central Java, Indonesia. By adding orange juice powder in the process of making yogurt, it is expected to add flavor and increase the vitamin C content of yogurt, as well as increase the selling value of Tawangmangu tangerine. Inoculums used in this research were *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, and *Lactobacillus acidophilus*. The results showed that the addition of Tawangmangu tangerine juice powder could increase the vitamin C content in yogurt. Highest vitamin C content was found on Tawangmangu tangerine juice powder 8% with a value of 6.23 mg/100g. Organoleptic test indicated that the addition of Tawangmangu tangerine juice powder increased panelists likeness for Tawangmangu tangerine yogurt, lowered level of fat and also increased the protein content in yogurt.

**Keywords:** *Citrus nobilis*, tangerine, Tawangmangu, vitamin C, yogurt

### INTRODUCTION

Yogurt (or yoghurt) is fermented milk having a sour taste and is known as a probiotic food product. Yogurt contains live bacteria that are beneficial for health and can survive in the human digestive tract, so it can perform its function in improving health and stimulating immune (Tamime 2006). Public awareness of drinking probiotic yogurt encourage yogurt producers to make innovation by adding a wide variety of fresh fruit pieces, fruit juice or fruit essence into yogurt. Djaafar et al. (2007) state that 60-80% of consumers prefer yogurt fruit and yogurt which is added with fruit flavor, fresh fruit, and sugar. This type of yogurt is preferred since it has better aroma and better taste than the plain yogurt. Citrus fruit is often added to yogurt products, not only because of the consumers like its typical taste, but also because citrus fruits have a lot of nutrients. Vitamin C is one of many vitamins that have benefit to the body. A well-known source of vitamin C is citrus fruit.

Tawangmangu tangerine (*Citrus nobilis* Lour. var. *Tawangmangu*) is local eminent varieties from Tawangmangu area, Karanganyar District, Central Java, Indonesia (IAARD 2010). Post-harvest processing of Tawangmangu tangerines receives less attention from the public. In fact, if the potential results of natural resource (SDA) are utilized effectively in an area, it can yield benefits for the region and can be an asset to the region. The fruits processing is one alternative to anticipate abundant fruit and fruits that cannot go to the market because of its low quality. In this study, utilization of Tawangmangu tangerine juice as a mixture of yogurt is

expected to add nutrition in yogurt i.e. vitamin C. It is also expected that it can increase the economic value of Tawangmangu tangerines.

### MATERIALS AND METHODS

#### Materials

Materials used in this study is the fruit powder of Tawangmangu tangerine which cultivated in Tawangmangu area, Karanganyar District, Central Java, Indonesia, a pure culture of *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, and *Lactobacillus acidophilus*, distilled water, de Man Ragosa Sharpe Broth (MRSB), de Man Ragosa Sharpe Agar (MRSA), cow's pure milk, skim milk, chemicals kit test of Kjeldahl protein, lipid level test of soxhlet method.

#### Procedure

The production of yogurt is in accordance with the modification of Dave and Shah (1997). The production of Tawangmangu tangerine powder uses foam mat drying method (Kamsiati 2006), Yogurt that has been created is analyzed its pH value (DSN 1992). Acidimetry and alkalimetry (acid-base titrations) methods are used to test the total acid (Fardiaz 1992). Hedonic method is used to test the organoleptic (Kartika et al. 1987). Kjeldahl method is used to do the protein content test (Sudarmaji et al. 1989). Lipid level test is to conduct (DSN 1992). Analysis of vitamin C content is to conduct (Sulaeman et al. 1994).

### Data analysis

The data obtained in this study are analyzed with Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT).

## RESULTS AND DISCUSSION

### Tangerine powder

Tawangmangu tangerine juice which was added in this yogurt is in powder form. The drying method to produce fruit juice powder easily is foam mat drying method. In this drying method, the drying temperature, the amount of filler and the amount of foaming agent are the main conditions to yield the right powder.

Tawangmangu tangerine juice powder made with foam mat drying method has a high solubility, yellow color as the color of fresh fruit, and the taste has not changed much and no precipitation occurs (Kumalaningsih and Suprayogi 2006). Figure 1 shows Tawangmangu tangerine juice produced which is yellow and in powder form.

From Figure 2, it can be seen that the more the addition of orange powder, the more yellow the yogurt become. This is because the orange powder is yellow, thus affecting the color of yogurt. According to SNI, one of the requirements to be probiotic drinks is that it contains a minimum of  $10^8$  lactic acid bacteria per mL. Based on the analysis of variance, it is showed that the addition of Tawangmangu tangerine powder did not significantly affect the amount of lactic acid bacteria. Viability of lactic acid bacteria in yogurt has significant meaning, given the presence of the bacteria contributes beneficial effects for health. At the end of fermentation, the amount of lactic acid bacteria has reached  $10^{12}$  bacteria per mL, and it is in accordance to SNI about minimum standards of probiotic drink that is at least  $10^8$  bacteria per mL. According to Ray (1996), the high number of probiotic bacteria cells in the human digestive tract will inhibit the growth of pathogenic bacteria.

Another criterion of probiotic drink is that it must have low pH, 4.5 for maximum and 0.5 % to 2.0% lactic acid levels. Lactic acid can affect the pH value of yogurt. If lactic acid is produced more, the pH of the yogurt is lower. After fermentation, the decrease of Yogurt pH is caused by the activity of lactic acid bacteria. According to Likah and Kristanti (2008), lactic acid bacteria in milk changes milk lactose into lactic acid. The amount of lactic acid that is formed yields the number of  $H^+$  ions dissolved increases, resulting in a decrease in pH. Jay et al. (2005) state that the yogurt pH ranges from 3.5 to 4.5, so that the pH of Tawangmangu tangerines yogurt have met these standards.

Yogurt has a high nutritional value and low lipid levels. Based on analysis of variance, the addition of tangerine powder has significant effect among the treatments in the yogurt produced. Yogurt lipid levels are lower than fresh milk. Decrease in lipid levels is the result of the activity of lactic acid bacteria which have lipase enzyme that functions to degrade lipids (Tamime and Deeth 1989). Lipid levels in yogurt tangerines Tawangmangu are qualified in accordance with DSN (2009) standards, namely a maximum of 3.8%.



**Figure 1.** Tawangmangu tangerine juice powder produced with foam mat drying method



**Figure 2.** Tangerines yogurt after 16 hours of fermentation

Drying is the reduction of the moisture content of materials so that decaying bacteria cannot live and the damage can be minimized. Kumalaningsih and Suprayogi (2006) say that drying in the foam form can accelerate the process of water evaporation, and since it is performed at low temperatures it does not damage the tissue cells, thus nutritional value can be maintained. With this method, the nutritional value can be maintained, and color rendition can be retained (Iswari 2007).

### Tangerines yogurt

In general, the making of yogurt uses only *L. bulgaricus* and *S. thermophilus*, but in this study, starter bacteria *L. acidophilus* is added because these bacteria can live longer in the digestive tract. According to Waspodo (2002), yogurt bacteria *L. bulgaricus* and *S. thermophilus* do not belong to probiotic bacteria. The bacteria *L. bulgaricus* and *S. thermophilus* only stay for a short period of time in the digestive tract; therefore their activities are not able to suppress the growth of pathogenic bacteria (Gilliand 1985).

Based on the method of production, in this study, yogurt belongs to set yogurt, namely the yogurt where the process of fermentation or incubation of milk is done in small packages, then the clotted milk remains intact and no change will occur when it is frozen or until it is ready to be consumed. Figure 2 shows that the addition of the tangerine powder affects the color of yogurt.

Protein is an essential nutrient for the body because it has a function as a body builder and body regulator substance. Protein is a source of acid. Based on analysis of variance, the granting of tangerine powder gives significant effect on yogurt. According to Gilliland (1985), a decrease and an increase in levels of protein in yogurt are influenced by the activity of lactic acid bacteria. Lactic acid bacteria have proteolytic characteristic; it is associated with the ability to use a milk protein as a source of N. From the analysis of proteins, yogurt with the addition of Tawangmangu tangerine powder has met the DSN (2009), namely minimum protein in yogurt is 2.7 w/w.

### Vitamin C

The nutrients contained in milk include vitamin C, although the content of vitamin C in the milk is only a few compared to the other nutrients in milk. Vitamin C serves to preserve the health of capillaries, health of teeth and gums and it can inhibit the production of nitrosamines. Nitrosamines are cancer-triggering substances (Tapan 2005). The addition of orange powder into the milk will increase the amount of vitamin C in it. Based on Analysis of Variance, Table 1 shows that the addition of Tawangmangu tangerine fruit powder into the yogurt bring up significant effect on the levels of vitamin C in the yogurt. Statistical analysis of the increase of vitamin C in yogurt shows significant difference among treatments. Significant different control occurs in the yogurt with tangerine juice addition of 4%, 6%, and 8%, but not so with the yogurt experiencing tangerine powder addition of 2%. The tangerine powder addition of 2% was not significantly different from that of 4%, but was significantly different from the tangerine powder addition of 6% and 8%.

Table 1 shows that the highest increase of vitamin C levels is with the addition of tangerine juice of 8%. The more tangerine powder is added to the higher vitamin C content in yogurt. Statistical analysis shows an increasing level of vitamin C in the yogurt before and after the fermentation has significant effect among treatments. Levels of vitamin C in Tawangmangu tangerine powder is 25,75mg/100g.

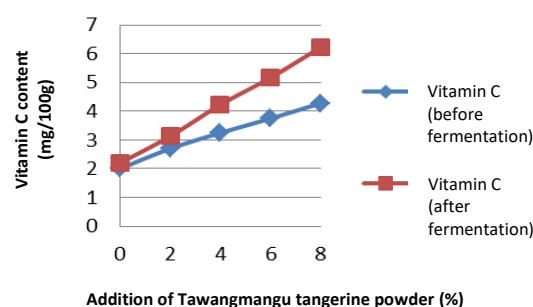
The addition of Tawangmangu tangerine powder in milk before fermentation increases the vitamin C content constantly, i.e. from 0.50 to 0.53 mg/100g. After fermentation, the content of vitamin C experiences a constant increase for about 0.90 mg/100g. The increase in vitamin C after fermentation is caused by the activity of lactic acid bacteria. Figure 3 shows the vitamin C content of yogurt before and after fermentation.

From Figure 3, it can be seen that before the fermentation, vitamin C content in yogurt is increasing constantly with the addition of Tawangmangu tangerine powder. According to Survase (2006), there were bacteria that can synthesize vitamin C through a fermentation process. Park and Cheigh (2004) stated that bacteria *L. acidophilus* can stimulate the production of vitamin B1 and synthesize vitamin C on kimchi; furthermore, the lactic acid bacteria and vitamin C can inhibit NO<sub>2</sub> and nitrosamines. The presence of *L. acidophilus* bacteria in yogurt can boost the vitamin C content of Tawangmangu tangerines yogurt such as in Korean kimchi production.

**Table 1.** Vitamin C content of milk before and after 16 hours fermentation

The addition of orange juice (%)	Vitamin C milk (mg/100g)		
	Before fermentation	After fermentation	Increase in vitamin C
0	2.00	2.20 <sup>a</sup>	0.20 <sup>a</sup>
2	2.70	3.13 <sup>b</sup>	0.43 <sup>ab</sup>
4	3.25	4.23 <sup>c</sup>	0.98 <sup>bc</sup>
6	3.75	5.17 <sup>d</sup>	1.41 <sup>cd</sup>
8	4.28	6.23 <sup>e</sup>	1.92 <sup>d</sup>

Note: the value of which is marked with the same letter are not significantly different in test of DMRT 5%



**Figure 3.** The content of vitamin C of yogurt before and after 16 hours fermentation

### Organoleptic test

An organoleptic test used in this study is pleasure/hedonic test. Fondness test is a test in which the panelists reveal its response in the form of pleasure or displeasure of the trait being tested by untrained panelists without comparing to standard samples. Testing was conducted on the texture, flavor, color, and aroma of Tawangmangu tangerines yogurt. Yogurt has a fresh flavor as a result of the production of various volatile components determining flavor such as diacetyl and acetaldehyde (Widodo 2003). Panelist assessment on the texture of Tawangmangu tangerines yogurt shows the addition of tangerine powder was not significantly different between treatments. The most preferred texture is control. Yogurt has a distinctive aroma due to the production of lactic acid produced by bacteria and the addition of Tawangmangu tangerine powder. The result of statistical analysis shows that there is no significant difference between treatments.

Based on statistical analysis, yogurt taste is significantly different between treatments. Control is significantly different with yogurt 6% and 8%, but it is not significantly different with yogurt 2% and 4%. Questionnaires which were given to the panelists show that the addition of Tawangmangu tangerines powder can improve the taste of yogurt so the panelists prefer the yogurt with the addition of Tawangmangu tangerines powder to the original one. Statistical analysis of yogurt color shows that the addition of tangerines powder is not significantly different between treatments. Yogurt color is usually white, with the addition of Tawangmangu tangerines fruit powder yogurt becomes yellowish white.

From the results of questionnaires given to the panelists, it is concluded that they declared neutral about the yogurt colors produced.

In conclusion, the more addition of Tawangmangu tangerine powder led to the higher content of vitamin C in the yogurt. The increasing levels of vitamin C are due to the activity of BAL. Tawangmangu tangerine powder reduces levels of fat and increases the protein content of yogurt. Organoleptic test shows that the panelists prefer the yogurt with the addition of Tawangmangu tangerine powder to the original one. Yogurt with the addition of Tawangmangu tangerine powder has met SNI standards.

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