Utilization of modified flour (maltodextrin) from yam starch for the manufacture of tomato extract encapsulate

Pemanfaatan tepung termodifikasi (maltodekstrin) dari pati bengkoang untuk pembuatan enkapsulat ekstrak tomat

Inda Three Anova* dan Kamsina
Industrial Standardization and Services Center of Padang
Jl. Raya LIK No. 23 Ulu Gadut, Padang, Indonesia
* e-mail: indova@gmail.com

ARTICLE INFO
Article history:
Accepted: 08 November 2022
Approved: 16 Desember 2022
Published: 30 Desember 2022

Keywords:
enkapsulat;
tomato (Solanum lycopersicum);
tomato juice.

ABSTRACT
Tomato (Solanum lycopersicum) is a popular vegetable and functional food ingredient. It is typically used to make fruit juice, which is then consumed directly or in a mixed form. The content consists of water, fiber, vitamins, and minerals and functions as an antioxidant. Therefore, this study aimed to utilize modified flour from yam starch as maltodextrin to produce tomato juice encapsulant. Yam starch maltodextrin encapsulation treatment consisted of 5%, 10%, 15%, 20%, 25%, and 30% aquadest for tomato juice (1:1). The yield, moisture, ash, and vitamin C content were calculated. The 30% treatment produced the highest yield value of 194 g, with water and ash contents of 5.21% and 1.59%, respectively. Meanwhile, the 5% treatment had the highest vitamin C of 0.77%.
1. Introduction

Tomato is one of the horticultural commodities in West Sumatra. However, it has not been widely developed in the form of processed products, which are usually consumed in fresh form. Due to a bountiful harvest, farmers receive low prices and even incur losses.

The fruit is used as a food source in households. In addition to the high vitamin C content, the water content is also quite high, making it very beneficial for health, particularly the skin. The use of tomato is currently still limited to household processing. Furthermore, only few individuals understand that this commodity can be made into several products to increase its resistance and quality (Laga et al., 2019).

Many studies have been conducted on processed tomato products, including dates (Laga et al., 2019; Ruslimin et al., 2021; Widyasari et al., 2019), anti-aging products (Surbakti and Berawi, 2016), velva (Astuti et al., 2021), product diversification for healthy and delicious snacks (Lismeri et al., 2019), edible coatings for post-harvest tomato (Solanum Lycopersicum) (Putra, 2022), and innovations in tomato products processing as an alternative to increasing the economy (Yuniastri et al., 2022). According to (Lismeri et al., 2019), tomato contains a compound called alpha lipoic acid which is helpful in controlling blood sugar, increasing vasodilation, protecting retinopathy in diabetic patients, and preserving the brain and nerve tissue. Among the nutrient compounds found include choline, which aid with sleep, muscle function, learning, and memory function. One serving of raw tomato (150 g) contains vitamins A, C, K, folate, and potassium. Additionally, the fruit also contains sodium, saturated fat, cholesterol, and low calories. It is a good source of minerals such as thiamin, niacin, vitamin B6 and magnesium, of which the majority of the population is unaware.

The distinctive color is caused by lycopene, carotene, xanthophyll, and chlorophyll dyes which are evenly distributed in the solid part of the fruit. Lycopene, or often referred to as α-carotene, is a bright red carotenoid pigment observed in tomato and other red fruits. This substance serves as an antioxidant, which is a health-promoting antidote to free radicals (Novita et al., 2015).

The current trend in food technology for protecting bioactive components from damage is encapsulation. It is a process of wrapping or coating the core material in liquid or solid form using a special encapsulant. This process provides the core particles with the desired physicochemical properties (Hapsari et al., 2022; Maesaroh et al., 2019; Ningsih et al., 2017).

In addition to protecting vital components, coating or encapsulating materials can also reduce the required drying time. This is because they can bind water from the fruit tissue. Therefore, during the drying process, evaporation occurs more easily compared to when the fruit juice releases its water (Wiyono, 2011). It is also observed that encapsulants reduce damage to antioxidant components and the antioxidative abilities (Sulisjaywati, 2019).

The most commonly used encapsulant is maltodextrin which helps eliminate the tendency of powder to stick to the spray dryer's wall and is a thickening agent or emulsifier (Dewi and Satibi, 2015; Tazar et al., 2017; Yeni et al., 2018). Modified flour extracted from yam starch as maltodextrin is a potential material to protect the active ingredients from environmental influences. This special starch flour is a renewable, natural, non-toxic, and edible biopolymer. In addition to being a coating/encapsulant, it can also be used simultaneously as a raw material for cosmetics and medicines (Yeni et al., 2021a).

Tomato has many benefits, but it does not keep fresh for long, and during the main harvest, the price drops. To increase the selling price, it is necessary to convert this fruit into processed products with high economic value and shelf life (Yuniastri et al., 2022). One of the ways is to process it into dry form using encapsulant technology. Maltodextrin is widely used as an encapsulant material (Dewi and Satibi, 2015; Tazar et al., 2017; Yeni et al., 2018), but studies have not been conducted on the use of modified flour from yam starch for coating tomato extract. As a result, this technology is expected to increase the added value of the products. This study aims to utilize maltodextrin from yam starch-modified flour as an encapsulant in tomato extract and determine its effect on yield, water, ash, and vitamin C contents.

2. Method
2.1. Material and equipment

The materials used were tomato, yam starch, HCl, ethanol, aquadest, and other ingredients, as well as chemicals for testing. The tools included juicers, magnetic stirrers, glassware, homogenizers, and spray dryers as well as testing equipment. This study also employed a completely randomized design (CRD) for the yam maltodextrin treatment in tomato extract, with concentration variations of 5%, 10%, 15%, 20%, 25%, and 30%.

2.2. Study design

The study on tomato extract encapsulation was performed in 3 (three) stages, namely a) tomato extraction, b) making modified yam starch flour, and c) tomato extract encapsulation.

2.2.1. Tomato extraction

Tomato extraction was conducted first by selecting good quality, not defective, and washed fruit. The next process was crushing using a blender. Subsequently, the obtained fruit pulp was then diluted using clean water in a ratio of 1:1 (one kg of pulp in 1 liter of water). The stage was then continued by filtering using a filter cloth to obtain a clear tomato juice.
2.2.2. Making modified yam starch flour

Yam starch of 100 mesh was mixed with 2% HCL and hydrolyzed for 75 hours. The results were washed with NaOH solution until a neutral pH was reached. However, when this is not achieved, neutralization is carried out by adding ethanol. The outcome is further dried using an oven at 50-60°C. The starch was ground with a porcelain mortar and continued sieving again to obtain a modified yam starch (maltodextrin) of 100 mesh.

2.2.3. Tomato extract encapsulation

The encapsulation of tomato extract was conducted using a completely randomized design with coating concentrations of 5%, 10%, 15%, 20%, 25%, and 30% maltodextrin. Tomato extract encapsulant product as in Figure 3.

The maltodextrin was dissolved in distilled water, stirred with a magnetic stirrer, and boiled for over 15 minutes, until the solution became transparent and homogenous. Following the addition of tomato extract (1:1), homogenization was continued for an additional 5 minutes. After obtaining a homogeneoues solution, the dried tomato extract was encapsulated using a spray dryer with inlet and outlet temperatures of 110-120°C and 70-80°C, respectively. Finally, the yield, as well as water, gravimetric ash, and vitamin C contents were calculated by spectrometry.

3. Results and discussion

3.1. Yield

The results of drying tomato extract coated with maltodextrin derived from yam starch were significantly different. The 30% treatment produced the highest yield of 194 g. Furthermore, along with the reduction in concentration, there was a decrease in yield. The lower the maltodextrin coating, the greater the water content, hence, the percentage of weight loss tends to be substantial. Finally, the significant weight loss affects the yield of the resulting encapsulated tomato extract.

This is in line with (Fridayana et al., 2018) and (Lestari et al., 2019), stating that the high yield is due to the greater amount of maltodextrin, which is more capable of interacting with the encapsulated fraction. Therefore, the greater the maltodextrin amount, the higher the total solids and yield of the encapsulated product. Figure 4 shows the results of calculating the yield of tomato extract encapsulate according to the treatment.

3.2. Water and ash contents

Figure 5 shows the water content of the tomato extract encapsulate. The resulting water content ranges from 5.21-8.11%, with the highest and lowest value being discovered in 5% and 30% maltodextrin coating concentration, respectively. The increase in water content and decrease in maltodextrin coating concentrations are because the absorbed compound cannot completely coat all the tomato extract. Therefore, the bond between the maltodextrin coating and the extract still contained much moisture, which resulted in high water content during drying. In contrast, the higher use of this encapsulant decreases the water content due to its ability to absorb water. The number of hydroxyl groups that are hydrophilic in maltodextrin affects the
potential to bind free water in food products (Affandi, M and Widjanarko, 2018; Gonardi et al., 2022).

Since one of the causes of food damage is high water content, hence, evaporation and drying are often performed. Low water content permits obtaining stabilizing activity that inhibits microbial growth to prolong shelf life (Yeni et al., 2021b).

Observation showed that the ash content of the encapsulate ranges from 1.59-3.5%, with the highest and lowest concentrations in the 5% and 20% maltodextrin treatment, respectively. In addition to ash, there are also other components in food, namely minerals. Despite the very small amount, the presence of food minerals is needed by the human body, as they function as building blocks and regulators. Some are even needed as constituents of bones, teeth, soft tissue, muscles, blood, and nerve cells, and others are required to regulate the body’s metabolism.

Ash content affects the quality of a food ingredient. It is calculated to determine the external and internal minerals from the beginning to the end of extract formation. The total minerals in a food ingredient indicate the ash content, the composition of which is dependent on the type and method of ashing. Food ingredient consist of 96% organic matter and water, while the remaining 4% are mineral elements. Furthermore, organic materials in the combustion process will burn but the components remain and are referred to as ash content (Kamsina et al., 2020; Yeni et al., 2021b).

3.3. Vitamin C content

The vitamin C content in tomato extract encapsulate ranged from 0.77-0.28% (Figure 4), with the highest and lowest value discovered in 5% A and 30% F maltodextrin concentrations, respectively. The measurement aimed to determine the vitamin C content in the encapsulant, which is greatly affected by temperature and time (Anova et al., 2021).

Vitamin C in tomato is not as high as in orange, but it can be utilized by the body to fulfill nutrient intake (Laga et al., 2019). The content in the encapsulant produced decreases with the increasing maltodextrin concentration added. This was because the resulting encapsulate became drier and contained more encapsulant, namely maltodextrin which does not contain vitamin C.

According to Farikha et al., (2013), vitamin C is one of the water-soluble vitamins. It is stable in acidic media, but easily degraded by heat in neutral and alkaline. The rate of degradation of ascorbic acid is proportional to the concentration of dissolved oxygen in the food. Furthermore, its stability will increase with decreasing pH values. According to (Sari et al., 2021) the tomato quality depends on the weight and the chemical content, such as vitamin C.

4. Conclusion

The process of utilizing modified yam flour (maltodextrin) for the manufacture of tomato extract encapsulate by treating with various concentrations gave the highest yield of 194 g at 30% maltodextrin. Similarly, the lowest water and ash contents of 5.21% and 1.59%, respectively, were observed at 30% concentration, while the highest vitamin C content of 0.77% was observed at 5%.
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Acknowledgment

The authors are grateful to the laboratory and the Head of Industrial Research and Standardization Agency Padang for providing suggestions and assistance in this study.

Reference


