Storage resistance and a level of panelist acceptance on tomatoes sauce enriched with kandis acid \((Garcinia cowa\) Roxb) extract as a preservative

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Abstract. Kandis \((Garcinia cowa\) Roxb) is a fruit plant contains chemical compounds such as phenols, flavonoid, alkaloid, saponins, ascorbic acid and hydroxyl-citric acid that are essential as antimicrobial and food preserving substances. The aim of this study is to use kandis as natural preservative to improve the storage of tomato sauce, hence minimize the use of synthetic food preservative. The study uses completely randomized design method with the treatments as follow; (A) using kandis extract that macerated with water inside 121°C autoclave for 15 minutes, (B) using magnetic stirrer set at 100°C for 8 hours, (C) using magnetic stirrer set at 60°C for 24 hours, (D) using the 1:1 mixture between ethanol and aquades for 24 hours, (E) control, without addition of kandis extract, and (F) with addition of citric acid. The tomato sauce products then examined through organoleptic test for their colours, taste, flavour and texture. The observations on pH and mold infestation were conducted weekly up until 6 (six) weeks. The result showed that the treatment A performed the most, indicated with sensoric score for taste, flavour and texture yielded respectively 4.08; 4.17; 4.08, with average pH 3.8 and mold infestation 35 colonies/g during 6 weeks of storage. This result is similar to what shown with the citric acid treatment as well as complies with SNI 01-3546-2004 (tomato sauce).

1. Introduction
Tomatoes are fruit that rich with vitamins and minerals. They contain vitamin A and C, in addition to some minerals that essential for human such as potassium, phosphate and calcium. Tomatoes also bear lycopene, a form of carotenoid, an antioxidant that develops further upon processing. The antioxidant contained in tomatoes is effective in preventing prostate cancer, breast cancer and cervical cancer; it also reduces tumors. Unfortunately, this fruit, along with its processed products, is vulnerable to microbial attack [1].

Processing tomatoes into sauce products involves heating and addition of ingredients that promote the prevention and inhibition of mold. Ingredients, which made from various spices, are the main inhibitors for mold. Tomato sauce is considered as product with high water content, hence it is prone to detriment. As it is made from tomato paste processed from ripen tomatoes, along with ingredients, whether added with permitted additives of not. Tomato sauce is food product made from tomatoes and with high water content, nevertheless durable due to the composition of acid, sugar, salt and preservative in it. [2–4].
On its moist condition, the tomato sauce product is easily damaged. The preservative, therefore, is needed to prolong its storage period. The synthetic chemical preservatives are massively used to suppress the growth of microbes. Preservatives are substances that added into food products in order to prevent the damage from decaying, acidification and decomposition induced by microbes (bacteria, yeast, mold). The preservatives in foods and beverages function to depress the growth of harmful microorganisms, avoid food oxidation, and preserve the nutrition contents [1, 5–7].

Until recently, the studies on natural preservatives to improve storage durability covering the topics on combined thermal and high pressure colour degradation of tomato puree and strawberry juice [8], effects of food additive into the vegetable processing for producing tomato sauce [1], the quality of sauce made from tomato, carrot and red oil-palm [9], characteristics of tomato paste with addition of citric acid during storage [10], the use of raw extract of water-soluble polysaccharides from durian seeds (*Durio zibethinus* Murr.) within the making of tomato sauce [11].

Kandis is made from the rinds of *Garcinia cowa* Roxb. It belongs to Guttiferae family, distributes generally along tropical region, especially in Asia. Kandis fruit is traditionally used as remedy for intestinal worms and food poisoning. The use of this fruit was reported as the medicinal substance for ulcers, diarrhea, hypertension, obesity, inflammation, liver damage among others, especially in relation to its contents of bi-flavonoid, hydroxyl citric acid, xanthones, benzophenone and organic acids. Furthermore, kandis is also used as anti-cholesterol, body slimming, food supplement or as other functional food products [12–15].

The use of kandis as preservative is perceived possibly from its antioxidant content from polyphenol group. In addition, garcinia is also rich of organic acids such as hydroxy citric acid (HCA). The biological activity of these secondary metabolites is very diverse, including as antimicrobial, antioxidant, anti-cancer and others. It is also spice element for Sumatran cuisines, such as for rending, satay, fish curry, spicy sour, jam, vinegar and pickles. Within those culinary, it acts as marinade and preservative that increase foods’ durability [16, 17]. Based on this information, kandis is potential to be used as preservative for tomato sauce, especially in increasing the storage period.

Kandis is considered widely distributed in West Sumatra Indonesia, commonly sold in traditional markets. The use of kandis in foods as marinade and preservative need further improvement to lengthen such functions. Therefore, to achieve that objectives, kandis needs to be treated with variably macerations to produce smaller kandis extracts that are transportable, highly durable and feasible to be used as natural food preservative.

2. Methodology

2.1. Materials and Equipment

The study took place in the laboratory of Institute for Research and Standardization of Industri, Padang. Primary materials consisted of kandis and tomatoes, in addition to aquadest, ethanol 70%, granulated sugar, salt, garlic, cinnamon, pepper and corn starch. Equipment for this study included blender, knife, stirrer, stainless steel pots and drainer. Examination apparatus comprised autoclave, Erlenmeyer flasks, stirrer rods, funnel, filter paper, pH meter, oven, colony counter, incubator and analytic scale.

2.2. Research Method

It used completely randomized design with 6 (six) treatments. They are as follow: (A) using kandis extract that macerated with aquadest using autoclave set at 121°C for 15 minutes; (B) macerated with aquadest at 100°C for 8 hours; (C) macerated with aquadest at 60°C for 24 hours; (D) macerated with mixture 1:1 of ethanol and aquadest; (E) control; and (F) added with citric acid.

2.3. Research Implementation

The making of tomato sauce preserved with kandis extract consisted of two main stages; extraction of kandis and tomato sauce processing with addition of kandis extract.
2.3.1. The making of kandis extract. Kandis was first rinsed to clean it, drained and mashed down. It was then macerated with aquadest, ethanol or adjusted to the treatments. Concentrates yielded from this stage then used in the making of tomato sauce.

2.3.2. The making of tomato sauce. Approximately a kilogram of fresh tomatoes was used in this process. After cleanly rinsed under running water, the tomatoes were blanched for 3 minutes at 80°C-90°C. After cooled down, the tomatoes were peeled. The fruit flesh then diced and smashed with blender, before filtered. Tomato paste yielded then heated, added with sugar, salt, garlic, pepper, cinnamon and kandis extract in accordance to provision stated for each treatment. Tomato sauce was cooked until condensed and then cooled down. The cooled sauce then sealed in the bottles, left around 2 cm space from the bottle lid to decompress air pressure. Bottled sauces were then pasteurized for 30 minutes in 70°C hot water. [1], [18].

2.4. Observation
Analysis performed on tomato sauce involved sensory evaluation on colours, taste, flavour and texture; while for its durability, the measurement on pH and microbial contamination were undertaken for each week.

3. Results and Discussion
3.1. pH and mold infestation during storage
Statistical analysis performed showed that tomato sauce treated with kandis extract differed significantly to other treatments. It can be seen in the Figure 1 below.

![Figure 1. pH and mold infestation during storage with treatment A, B, C, D, E, and F.](image)

Figure 1 shows that initial pH of tomato sauce ranged between 3.00 – 3.20, which increased in accordance to the storage time. On the sixth week of study, the control treatment (E) gave the higher pH at 4.70, significantly differed than other treatments. The lowest pH during the same time indicated at tomato sauce treated with citric acid, measured at 3.70. This measurement was not differed with treatment A, where tomato sauce treated with kandis macerated with aquadest within autoklave set at 121°C for 15 minutes.

The pH value is required as part of quality standards for tomato sauce as stated in SNI 01-3546-2004. It should be range between 3 – 4 [11]. Moreover, pH is an important parameter to standardize the quality of tomato sauce [11]. Thorough observation on pH during storage is crucial for controlling product quality as it will be impacted by the changing of pH. Any pH changing during storage indicates existing reaction or the damage on any product component that shown through the fluctuation of pH. Figure 1 also indicates that pH of all tomato sauce treatments went along with the
quality standard at week four. However, at the sixth week, only treatment A, D and E that still complied with the quality standard.

Treatment F (with addition of citric acid) at the sixth week indicated the lowest pH value, not too differed with what observed in treatment A. The low pH value was thought to relate with organic acid contents within the tomato sauce. It is also possible from the addition of citric acid during the making of sauce, however, it showed insignificant differences with the pH measured in treatment A. The content of acidic acid in fruits will correlate to acidity of food products made from them [19–21].

The analysis on microbial contamination (such as mold) in tomato sauce can also be seen in Figure 1. The mold was detected within tomato sauce as many as 14 - 80 colonies/g. According to SNI 01-3546-2004, limit for mold infestation in tomato sauce should not exceed 50 colonies/g [2]. Figure 1 shows that, at the sixth week, the tomato sauce stored at 25°C in treatment A (with 35 colonies/g), in treatment D (40 colonies/g) and treatment F (30 colonies/g) are still complying with the requirements stated in SNI 01-3546-2004, while other treatments are not.

Molds are saprophytic microbials that live onto other organisms due to their inability to supply their nutrition needs through autotrophic mechanism. The growth of mold is affected by temperature, pH, humidity, water content and time period [5]. Figure 1 indicates that along the storage time, the pH and mold colony were also increasing. The development of microorganisms during the storage of tomato sauce is supported through the breakdown of alkaline amino acids, as they cannot consume amylose or other simple sugars that produce organic acids. This, in turn, what in increase the pH of tomato sauce [5, 6].

3.2. Organoletic Test
Oraganoleptic examination evaluated colour, taste, flavor and texture of tomato sauce treated with macerated kandis and addition of citric acid. Statistical analysis shows significant result for each treatment as seen in Figure 2 below.

![Figure 2. Organoleptic value on stored tomato sauce using treatment A, B, C, D, E and F.](image)

Color is an important component in organoleptic test as it defines product quality and consumers’ level of acceptance to a certain product. The value for the color of tomato sauce range between 3.83 – 4.17 (reddish orange to brownish). It is indicated that these colours are likeable by the evaluation panelist. The highest value was given to the treatment with addition of kandis extract (D) and addition of citric acid (F), both with score 4.17. Followed with treatment E, scored at 4.08 with reddish orange colour [22]. Meanwhile, the treatment A, B and C result in brownish orange colour. This was presumed as result from the treatment using macerated kandis extract with aquadest.
The evaluation data for examined taste, as shown in Figure 2, range between 3.75 – 4.08 (likeable). Treatment A (tomato sauce added with macerated kandis extract with aquadest using autoclave set at 121°C for 15 minutes) was scored the highest 4.08 and significantly different with other treatments.

Taste is one main attribute for consumers in accepting or rejecting a certain food product. Even though other parameters are deemed good, if the taste is not palatable, the food product will be rejected. Humans perceive four basic tastes; salty, sour, sweet and bitter. While other tastes are from the mixture of these four basic tastes. Taste is a response unto chemical stimuli on tasting buds, especially on those four basic tastes; salty, sour, sweet and bitter. Furthermore, the taste of tomato sauce is influenced by the addition of hydroxyl citric acid (HCA) and oxalate acid contained within dried rind of kandis; these what invoke fresh fruit sensation [1, 23, 24].

Flavor is also crucial for food products, aside from their colour and taste. The average score for sensed flavor of tomato sauce range between 3.75 – 4.17 (likeable) as seen in Figure 2. The most likeable flavor, according to the organoleptic panelist, was one that perceived from tomato sauce treated with treatment A (macerated kandis extract with aquadest using autoclave set at 121°C for 15 minutes) and significantly different to other treatments’ scores. A distinctive aroma was able to invite the panellist to try this product. The flavor is detected through the volatile substance that enter nasal cavity and perceived by olfactory system and translated by brain [1].

The score for sensed texture in this study range between 4.00 – 4.08, where the highest score (4.08) achieved by treatment A, D and F, while the rest of the treatment only reached score 4.00. In all treatments, the tomato sauce products showed a stable texture.

Semi-moist food products will show their stability upon the change of thickness. When it happens, the products have been possibly generating. The thickness is one parameter which influential to the quality of tomato sauce, especially as it determines the sauce texture. The change in sauce texture impact the taste and flavour, in turn influencing the perceiving time that happened in receptor cell of olfactory system, as well as in salivary gland [24, 25].

4. Conclusion
The result showed that the best treatment for tomato sauce product yielded from adding macerated kandis extract with aquadest using autoclave set at 121°C for 15 minutes. This treatment optimizes the taste, flavour and texture examined using organoleptic test with scores respectively 4.08; 4.17; 4.08; pH 3.8 and mold infestation 35 colonies/g during 6 weeks of storage. This result is indifferent with what shown through the treatment of citric acid addition and also complies with SNI 01-3546-2004 (issued for tomato sauce)

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