Research article

Evaluation of the Acceptability of Cashew Apple Jam in Cambodia

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Abstract This study aimed to evaluate the acceptability of cashew apple jams based on a sensory evaluation test in Cambodia. Sensory evaluation tests for 2 types of cashew apple jams were conducted in Phnom Penh, Cambodia, and in Setagaya, Japan, in September 2019 for 70 persons. The jam raw materials were cashew apple, sugar, low-methoxyl pectin, and citric acid. These materials were mixed, dissolved, condensed, and prepared to 50 °Brix sugar content while heating to approximately 80°C. The jam heated to 80°C was filled in a glass bottle. We called this sample a hot-pack jam. The hot-pack jam was reheated at 90°C for 20 min in a sterilization process. After 20 min, the jam was kept at room temperature for cooling with sterilization. We called the sample with the sterilization procedure a reheated jam. The color, sweetness, acidity, taste, flavor, jelly state, smoothness, and overall score of each sample were evaluated using a five-point hedonic scale (1: hate, 2: dislike, 3: neutral, 4: like, and 5: like very much) in the sensory test. The hot-pack and reheated jams were tested by 40 panelists of Cambodian students and faculty members at the Royal University of Agriculture, Cambodia (RUA), and Tokyo University of Agriculture, Japan (TUA). Thirty citizens evaluated only reheated jam at a supermarket in Phnom Penh. Almost all panelists answered that the reheated jam was sweeter than the hot-pack jam. Because the scores of both jams given by panelists ranged from 3 to 4, the cashew apple jam was considered to be acceptable and had a possibility to become a new processed food in Cambodia.

Keywords cashew apple, jam, sensory evaluation, acceptability

INTRODUCTION

New processed food made from local sites is expected to increase income for farmers and support their independence. The cashew (*Anacardium occidentale* L.) is originally from Brazil and is also cultivated in tropical areas (Honorato and Rodrigues, 2010; Oliveira et al., 2020). The cashew nut is a part of the cashew fruit, which contains an edible pedicel called the cashew apple (Janick and Paull, 2008).

In Cambodia, the cashew plant is an industrial crop. The total yield of cashew nuts was 136,094 tons in 2018, and the largest cultivation areas in Cambodia were the provinces of Kampong Thom (58,624 ha), Ratanakiri (30,459 ha), Kratie (27,761 ha), and Kampong Cham (24,364 ha) (MAFF/GDA, 2018). However, only cashew nuts are commercialized; and the rest of the cashew fruits (cashew apples) become wastes. Providing a way to utilize cashew apple will support the economy of the agricultural industry. The cashew apple is rich in vitamin C (five times more than that in oranges) and minerals and is good for health (Akinwale, 2000). The cashew apple exhibits antibacterial properties, treating gastritis and ulcers in the stomach and preventing scurvy (Melo et al., 2003). Cashew apples can be eaten fresh, cooked in curries, used for fermented vinegar, consumed as alcoholic and nonalcoholic drinks, and used to make preserved food, chutneys, and jam (Ogunsina et al., 2008). Codex Alimentarius International Food Standards (CXS 296-2009, 2017) reported that jam is the product brought to a suitable consistency, made from the whole fruit, pieces of fruit, unconcentrated and/or concentrated fruit pulp or fruit puree. Jam is made of one or more fruits and is mixed with foodstuffs with sweetening properties with or without water. There are many reports about methods of preparing jam from various fruits and their sensorial attributes. Ajenifujah-Solebo et al. (2011) examined the possibility of producing jam from black plums and evaluated its physicochemical properties, nutritional properties, and consumer acceptability. Ho et al. (2020) studied the proximate composition, physicochemical characteristics, and sensory evaluation of reduced-calorie belimbi fruit (*Averrhoa belimbi*) jam with maltitol.

The appropriate procedure for processing fruit and making jam is different from the characteristics of using fruit. Jam in this study is processed from cashew apple pulp, sugar, low-methoxyl (LM) pectin, and citric acid. Some jam products are sold in Cambodia, but they do not appear to be common,

especially for local Khmer. Sensory evaluation is necessary to grasp whether a new cashew apple jam is preferred in Cambodia.

In this study, we investigated the acceptability of cashew apple jams based on a sensory evaluation in Cambodia. The sensory analysis of two types of cashew apple jams was conducted in Phnom Penh, Cambodia, in September 2019 with 70 persons. The jam is a gelled ready-to-eat product and has many uses, for example, bread, milk-product, sweets, and so on. The jam is easy to make without the need for any special devices and skills. The jam also can keep at room temperature. Therefore, we conducted the sensory evaluation of the cashew apple jam.

OBJECTIVE

The objectives of this study were 1) to survey Cambodian citizens regarding the sensory evaluation of cashew apple jams and 2) to evaluate the acceptability for the sensory characteristics for cashew apple jams.

METHODOLOGY

Materials and Product Process of Jam

Cashew (*Anacardium occidentale* L.) fruit (cashew apple and nut) was purchased in Kampong Cham Province, Cambodia, and was stored in a refrigerator at approximately -18 °C until processing into jams. The cashew apple jam was made from 400 g of cashew apple paste, 300 g of sugar, 3.4 g of LM pectin, and 2.4 g of citric acid. Fig. 1 shows the production process of 2 types of cashew apple jams.

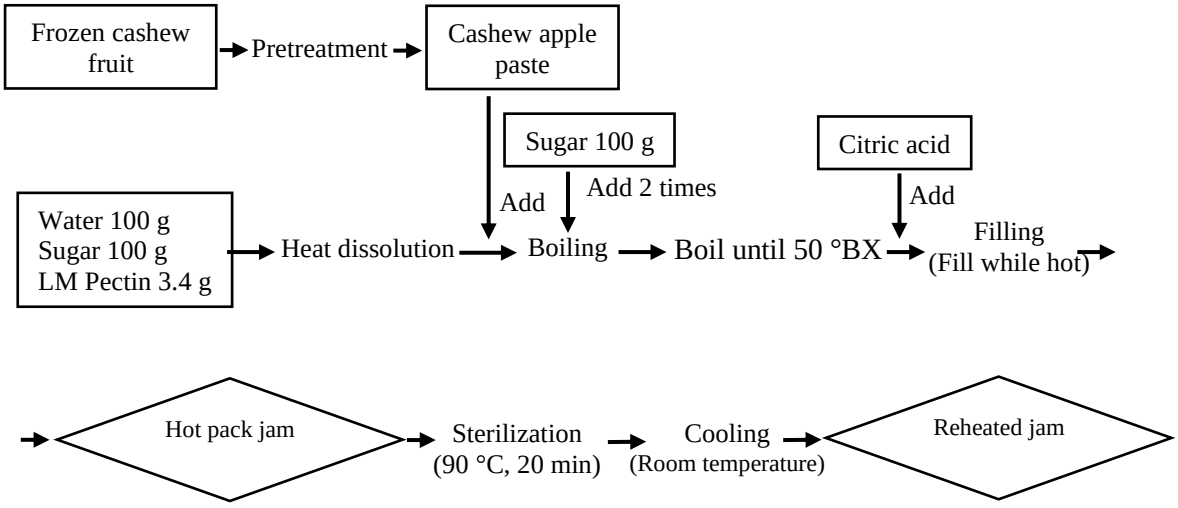

Fig. 1 Product process of 2 types of cashew apple jams: a hot-pack jam and a reheated jam

In the pretreatment of cashew apple paste, the frozen cashew fruit was thawed at room temperature. Then, the seed (cashew nut) and peer were removed from the cashew apple. The peeled fruit pulp (cashew apple) was crushed with a food processor for 2-3 min because there was substantial fiber in the pulp, and it did not fall apart even when boiled. During heat dissolution, LM pectin was mixed in 100 g of sugar in advance and dissolved in 100 g of boiling water. As pectin is difficult to dissolve in water, it must be mixed with sugar beforehand. After heat dissolution, 400 g of cashew

apple paste was added to the sugar and LM pectin solution. Keeping boiling this mixture, 100 g of sugar was added to this mixture twice. The boiling process took a total of 6-10 min. This mixture was boiled and concentrated up to 50 °Brix. After stopping heating, citric acid dissolved in a small amount of water was added to this concentrate. While hot, the jam was filled into a glass bottle up to 3-5 mm from the bottle lid. After closing the lid of the bottle, the bottle was turned upside down. We call this sample "hot-pack jam" in this manuscript. The hot-pack jam was sterilized for 20 min in hot water at a temperature of 90°C. We call the jam with the additional sterilization process "reheated jam". After sterilization, the reheated jam was cooled to room temperature.

Fig. 2 shows photographs of the hot-pack and reheated jams. Each bottle contained 90 g of jam. Considering the sanitary conditions in Cambodia, the sterilization process was added to the hot-pack jam. As a result, as shown in Fig. 2, the browning phenomenon occurred in the reheated jam. The component composition of these jams was the following: moisture, 47.1%; protein, 0.40%; fat, 0.1%; ash, 0.2%; carbohydrate, 52.3% (sugar, 50.6%; dietary fiber, 1.7%).

Fig. 2 The hot-pack and reheated jams

Sensory Evaluation

Sensory evaluation plays an important role in assessing the acceptance of new food products and preferences for different consumers (Banaś et al., 2018). The color, sweetness, acidity, taste, flavor, jelly state, smoothness, and overall score of each sample were evaluated using a five-point hedonic scale (1: hate, 2: dislike, 3: neutral, 4: like, and 5: like very much) at the sensory test (preference type). The hot-pack and reheated jams were tested by 40 panelists consisting of Cambodian students and faculty members at the Royal University of Agriculture, Cambodia (RUA), and Tokyo University of Agriculture, Japan (TUA). These panelists are represented as the RUA group in this research. Thirty citizens evaluated only reheated jam at a supermarket in Phnom Penh, Cambodia. The time and space for sensory evaluation of jam were limited in this case. The reheated jam received favorable evaluation results in the RUA group. The reheated jam is safer than the hot-pack jam. Therefore, only reheated jam was evaluated at the supermarket. The panelist ages of the RUA group and citizens were 19-55 years (average: 22) and 18-64 years (average: 27), respectively.

RESULTS AND DISCUSSION

The sensory evaluation results of both cashew apple jams from the RUA group are represented in Fig. 3. The average scores of sensory evaluation items for the hot-pack jam and the reheated jam ranged from 2.7-3.0 and 3.3-3.9, respectively. The reheated jam had higher scores than the hot-pack jam except for the color. The average values of all evaluation items for the hot-pack and reheated jams were tested for differences between population means (paired t-test), and there was a significant difference (5% significance level) between all items, except for acidity. Although the average value of

the color for the reheated jam was 3.3, this value was lower than that for the hot-pack jam (3.7). The occurrence of the browning phenomenon in the reheated jam affected this result. The average scores of the reheated jam were higher than those of the hot-pack jam except for the color. Because the score of the reheated jam for color was over 3: neutral, we considered that the color of the hot-pack jam was more favorable than that of the reheated jam but not unacceptable in the RUA group. The average sweetness, taste, and overall evaluation scores for the reheated jam were nearly 4.0, and the reheated jam received a high evaluation from the RUA group, which means that the reheated jam was more favorable. This result indicates that the addition of heat to the cashew apple jam after filling in the bottles influenced the final product characteristics and sensorial acceptance.

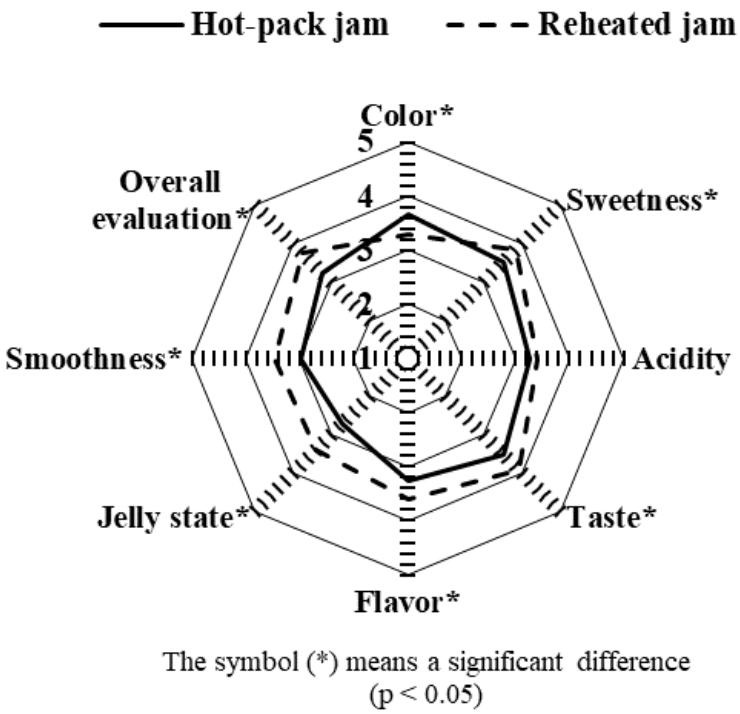

Fig. 3 Sensory evaluation results of the hot-pack and reheated jams in the RUA group

Fig. 4 shows the sensory evaluation results of the reheated jam from citizens, with a comparison to the results for the RUA group. The average score of the sensory evaluation items by the citizens ranged from 3.3 to 4.0, which was higher than that for the RUA group. Compared to the RUA group, the citizens highly evaluated the color of the reheated jam, and there was a significant difference (5% significance level) between the evaluation results of the color for both groups. A t-test for differences between population means for each evaluation item of the reheated jam (significance level of 5%) showed no significant differences between citizens and the RUA group, except for color. The average score of the overall evaluation for citizens was 4.0, and citizens also gave the reheated jam high evaluation scores.

Almost all panelists answered that the reheated jam was sweeter than the hot-pack jam. One of the possible reasons for this result is that the sweetness of the reheated jam increased because the sourness decreased due to volatilization caused by heating (sterilization). The cost of cashew apple jam made in Japan will be approximately 80 Japanese yen, including the glass container and the lid, based on the assumption that cashew apples can be obtained for free, the loss of materials and/or products during processing is negligible, and 600 units of jam (100 g per container) per 1 batch can be made. Because RUA group and citizens gave relatively high evaluation of the hot-pack jam and reheated jam, these

cashew apple jams were acceptable and had the possibility to become new processed foods in Cambodia. The sweeter jam was preferred in Cambodia. For improved food safety, we recommend adding sterilization to the jam-making process. The potential of cashew apples in jam making, product development, reduction of postharvest losses, creation of job opportunities, and so on would contribute to Cambodia's development.

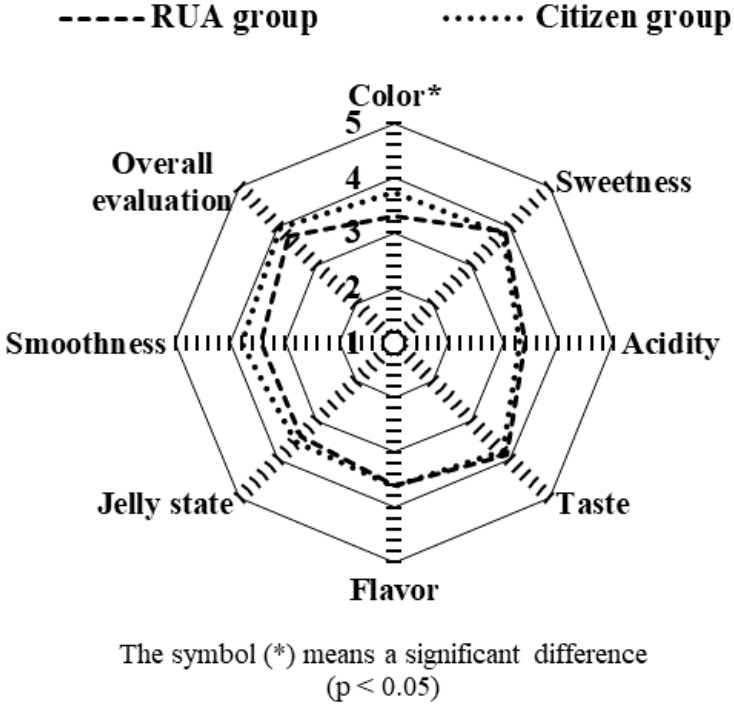

Fig. 4 Comparison of the sensory evaluation results of the reheated jam between the RUA group and 30 citizens

CONCLUSION

A sensory evaluation test of two types of cashew apple jams was conducted in Phnom Penh, Cambodia, in September 2019 with 70 persons. During the production of the hot-pack jam, the jam's raw materials were mixed, dissolved, condensed, and prepared to 50 °Brix sugar content while heating up to approximately 80 °C, and this jam heated to 80°C was filled in a glass bottle. Another jam, i.e., reheated jam, included a sterilization procedure to the hot-pack jam preparation process. The color, sweetness, acidity, taste, flavor, jelly state, smoothness, and overall score of each sample were evaluated using a five-point hedonic scale (1: hate, 2: dislike, 3: neutral, 4: like, and 5: like very much) for the sensory test (preference type). Both jams were evaluated relatively highly by the 70 panelists. The cashew apple jams were acceptable and had the possibility becoming new processed foods in Cambodia. Such a development will reduce postharvest losses, which have been a challenge to Cambodia's food technologists, as well as help create job opportunities and contribute to Cambodia's development.

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