Particular qualities of formation of sensory characteristics of jam made from the fruits from musky squash

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Abstract. The goal of the research is to study particular qualities of formation of sensory characteristics of jam made from the fruits from musky squash (synthetic varieties of Tsukatnaya and Moskovskaya aromatnaya produced by LLC «N.N. Timofeev plant breeding station»). The authors conducted biometrical observation and identified descriptors that described technological properties of fruits and maturation dynamics. The jam was made with the addition of fruit raw materials and the replacement part of the water in the sugar syrups with apple juice and a sensory assessment of the quality of the finished product was carried out. The studied varieties of musky squash during the growing seasons of different weather conditions showed high stability in the formation of the yield of the raw material, leveled by the maturity degree. Storing the fruits of the studied varieties of musky squash after harvesting for at least 2-3 months improves the technological properties of the raw material, which has a positive effect on the formation of the sensory characteristics of the finished product. The bright orange pulp of the studied pumpkin varieties with an average carotene content from 10.13 (Moskovskaya aromatnaya) to 13.3 mg% (Tsukatnaya variety) has a pronounced sweet taste and a pleasant aroma. This allows getting the highest quality jam by replacing 25% of the water in the sugar syrup with apple juice or adding 25% apples to the squash fruit. The fruits of musky squash varieties of Tsukatnaya and Moskovskaya aromatnaya produced by LLC «N.N. Timofeev plant breeding station» used in the jam production were grown in the Moscow region. This results in the formation of sensory characteristics representative of a high-quality product.

1. Introduction

When using plant raw materials, the quality of food products in their production is determined primarily by the varietal characteristics of the cropper and, to a lesser extent, by the processing conditions, which can be clearly seen by the example of squash [1]. Squash, which is one of the health-preserving products, is definitely included in the menu of medical and baby food. Squash contains a number of physiologically active substances, in particular pectin and fiber, which have pronounced protective properties and are also characterized by a high content of β-carotene [2]. At the
same time, almost all plant parts are valuable for squash, including fruit pulp, seeds, flowers, and leaves [3].

Due to the fact that the main task of the independent branch of the food and agricultural industry that has been formed in recent years is the production of natural food products, food companies are increasingly investing in healthy food [4]. In their production, the use of raw materials with certain characteristics is of great importance to the formation of certain properties in the process of growth which is possible by developing new varieties and hybrids of crops.

Taking into account the achievements of local plant selection breeders in working with cucurbits crops, it is highly relevant to study the influence of the specific and varietal technological properties of squash on the formation of the sensory characteristics of a certain type of finished product.

Scientific research in the field of technological evaluation of modern varieties and hybrids of squash has been performed at RSAU - MTAA. Various types of squash are studied for the manufacture of concentrated fruit canned food and technologies for the production of candy products [5] and snack products, as well as jam [6] made from squash fruits with the addition of fruit raw materials that contain natural organic acids necessary to balance the taste of the processed canned food. Studies carried out at Mogilev technological university showed that the addition of concentrated apple juice to the jam gave the product a pleasant taste and aroma and increased the nutritional and biological value of canned food.

The goal of the research is to study particular qualities of formation of sensory characteristics of jam made from the fruits from musky squash [7].

2. Materials and methods
The research was carried out at the Department of Storage and Processing Technologies for Fruit and Vegetables and Plant Products of State Agrarian University - Moscow Timiryazev Agricultural Academy and LLC «N.N. Timofeev plant breeding station».

The objects of research were synthetic varieties of musky squash harvested in 2016-2017: Tsukatnaya and Moskovskaya aromatnaya.

In the squash fruits of the studied varieties at the end of the growing season and during storage, the nature of the surface and shape of the fruit, the thickness, color, and taste of the fruit pulp, as well as other indicators characterizing the technological properties of the fruits and the dynamics of their ripening were determined. The chemical composition of raw materials was determined according to generally accepted methods.

Jam production from squash fruits was carried out in accordance with generally accepted methods with the ratio of 100 parts of fruits to 119 parts of sugar with the addition of citric acid in the control sample at the rate of 3.75 kg per 1000 kg of the finished product as well as in accordance to the design of an experiment with the addition of raw fruit materials and replacement part of the water in sugar syrup with apple juice. The obtained samples of the finished products were subjected to sensory analysis. During this analysis, the following characteristics were of great importance: visual appeal, the color of fruit fraction, the color of syrups, fruit cutting, transparency of syrups, and consistency of fruit pieces, flavor, general taste, fruit taste, and syrup taste. The indicators were assessed on a 5-point scale with subsequent recalculation taking into account the coefficient of significance.

3. Results
To make a high-quality jam the squash fruits must be at maturity. During harvesting in the first decade of September, almost all musky squash fruits of the study varieties had picking maturity and couldn’t be used for jam production. The studied varieties, above all, the Tsukatnaya variety, showed high stability in making the yield. Under different weather conditions of a specific growing season, fruits that were quite even in ripeness were obtained.

Maturation dynamics of squash fruits after the harvesting showed that for stored products to reach a technical stage of maturity, at least 2-3 months are required, during that sensory characteristics of raw materials are changed.
In the course of the research, differences characterized the technical stage of maturity and picking maturity of musky squash of study varieties were noted. This is especially clearly demonstrated by the example of the consistency of the fruit pulp, which in the Moskovskaya aromatnaya variety becomes rather loose at the biological stage of maturity (Table 1), which reduces the likelihood of obtaining high-quality products from such squash fruits.

Of special note are the taste and aroma characteristics of the fruit pulp of the studied varieties of musky squash, characterized by a pronounced sweet taste and a pleasant aroma. The intense orange color was due to a high level of carotene from 10.13 (Moskovskaya aromatnaya) to 13.3 mg% (Tsukatnaya). All of this makes it possible to obtain attractive in appearance and taste finished products, in particular, jam is almost close to ideal. This is evidenced by the results of the sensory analysis carried out.

**Table 1. Description of musky squash fruits**

| Characteristic                              | Moskovskaya aromatnaya | Tsukatnaya |
|---------------------------------------------|------------------------|------------|
| Fruit                                       |                        |            |
| Surface                                    | smooth                 | segmented  |
| Shape                                       | Club shaped with constriction | flat-round |
| Pulp                                        |                        |            |
| Average thickness, cm                       | 3.50                   | 4.50       |
| Decrease, cm                                | 1.0                    |            |
| Colour                                      | technical stage of maturity | orange    |
|                                            | biological stage of maturity | brilliant orange |
|                                            | during picking         | yellowish-orange |
| Density                                     | technical stage of maturity | high |
|                                            | biological stage of maturity | average loose enough |
| Juiciness                                   | juiced                 | averaged juiced |

The jam made from the fruits of the studied varieties of musky squash was distinguished by very attractive appearance (average grades are from 4.73 to 5.0 points) and very good taste (average grades are from 4.76 to 5.0 points). At the same time, the addition of 15% apples turned out to be insufficient for the formation of optimal sensory characteristics, so the finished product received average grades from 9.62 (Tsukatnaya variety) to 9.66 points (Moskovskaya aromatnaya variety).

When using the fruits of the Moskovskaya aromatnaya variety in jam, there was a slight decrease in the level of assessments for the taste of fruits and syrup. Therefore, having higher ratings in terms of attractiveness, appearance, and general taste, the finished product, in general, was also rated at 9.66 points. Integrally, jam made from the fruits of the studied varieties of musky squash was assessed at the same level, in proceedings of which 50% of the water in the sugar syrup was replaced with apple juice (average grades are from 9.67 to 9.75 points).

The formation of the most optimal sensory characteristics in the finished product was observed in samples when 25% of water, sugar syrup was replaced with apple juice when 25% of apples were added. At the same time, when 25% of apples were added, a finished product of the highest quality was obtained, and stability in quality indicators was observed regardless of the year of research: from 9.90 to 9.92 points for Tsukatnaya variety and from 9.97 to 9.98 points for Moskovskaya aromatnaya.
variety with an average rating taking into account the coefficient of significance from 9.91 (Tsukatnaya variety) to 9.98 points (Moskovskaya aromatnaya variety).

In the version with the replacement of 25% water in the sugar syrup with apple juice, depending on the variety, some variation was observed. Jam of the highest quality was obtained in 2016 from the fruits of the Tsukatnaya variety (score 9.88 points), in 2017 from the fruits of the Moskovskaya aromatnaya variety (9.84 points).

Table 2. Sensory evaluation, grade

| Characteristic | Year of research | Variety | Replacing part of the water in the sugar syrup with apple juice | With apple addition |
|----------------|------------------|---------|---------------------------------------------------------------|--------------------|
|                |                  |         | 25%   | 50%   | 15%   | 20%   | 25%   | 25%   | 50%   | 20%   | 25%   |
| Visual appeal  | 2016             | Ts*     | 4.96  | 4.93  | 4.70  | 4.97  | 5.00  | 4.97  | 4.93  | 4.70  | 4.97  | 5.00  |
|                |                  | MA**    | 4.84  | 4.78  | 4.60  | 4.87  | 5.00  | 4.87  | 4.78  | 4.60  | 4.87  | 5.00  |
|                |                  | Ts*     | 4.97  | 4.95  | 4.85  | 5.00  | 4.95  | 4.97  | 4.95  | 4.85  | 5.00  | 4.95  |
|                |                  | MA**    | 4.92  | 5.00  | 4.85  | 4.90  | 5.00  | 4.92  | 4.92  | 4.85  | 4.90  | 5.00  |
|                |                  | Ts*     | 4.97  | 4.94  | 4.78  | 4.99  | 4.98  | 4.97  | 4.94  | 4.78  | 4.99  | 4.98  |
|                |                  | MA**    | 4.88  | 4.89  | 4.73  | 4.89  | 5.00  | 4.89  | 4.89  | 4.73  | 4.89  | 5.00  |
|                | average          | Ts*     | 4.96  | 4.93  | 4.67  | 4.80  | 5.00  | 4.96  | 4.93  | 4.67  | 4.80  | 5.00  |
|                |                  | MA**    | 4.88  | 4.81  | 4.77  | 4.90  | 5.00  | 4.88  | 4.81  | 4.77  | 4.90  | 5.00  |
| Taste (general)| 2016             | Ts*     | 4.90  | 4.97  | 4.85  | 4.91  | 4.98  | 4.90  | 4.97  | 4.85  | 4.91  | 4.98  |
|                |                  | MA**    | 4.95  | 4.91  | 4.89  | 4.92  | 5.00  | 4.95  | 4.91  | 4.89  | 4.92  | 5.00  |
|                |                  | Ts*     | 4.93  | 4.95  | 4.76  | 4.86  | 4.99  | 4.93  | 4.95  | 4.76  | 4.86  | 4.99  |
|                | average          | MA**    | 4.92  | 4.86  | 4.83  | 4.91  | 5.00  | 4.92  | 4.86  | 4.83  | 4.91  | 5.00  |
|                |                  | Ts*     | 9.88  | 9.71  | 9.48  | 9.58  | 9.90  | 9.88  | 9.71  | 9.48  | 9.58  | 9.90  |
|                |                  | MA**    | 9.69  | 9.54  | 9.57  | 9.64  | 9.97  | 9.69  | 9.54  | 9.57  | 9.64  | 9.97  |
|                |                  | Ts*     | 9.76  | 9.79  | 9.75  | 9.81  | 9.92  | 9.76  | 9.79  | 9.75  | 9.81  | 9.92  |
|                | average          | MA**    | 9.84  | 9.79  | 9.74  | 9.68  | 9.98  | 9.84  | 9.79  | 9.74  | 9.68  | 9.98  |
|                |                  | Ts*     | 9.82  | 9.75  | 9.62  | 9.70  | 9.91  | 9.82  | 9.75  | 9.62  | 9.70  | 9.91  |
|                |                  | MA**    | 9.77  | 9.67  | 9.66  | 9.66  | 9.98  | 9.77  | 9.67  | 9.66  | 9.66  | 9.98  |

* – Tsukatnaya variety, ** – Moskovskaya aromatnaya variety

It should be especially noted that the production of jam with the addition of 25% apples to squash fruits made it possible to obtain from the squash fruits of the Moskovskaya aromatnaya variety finished product of the highest quality, which, in terms of taste and visual appeal, received the highest rating of 5.0 points. At the same time, the jam was very aromatic, and the overall score, taking into account the coefficient of significance, was at the level of 9.98 points.

In all studied versions, the finished product had a good aroma depending on the year of research and the variety. It was evaluated from 4.72 (Tsukatnaya variety, 2016, replacing 50% of water in sugar syrup with apple juice) to 4.76 points, (Moskovskaya aromatnaya variety, 2016, replacement of 50% of water in sugar syrup with apple juice) and from 4.97 (Moskovskaya aromatnaya variety, 2017, addition 25% of apples) to 5.00 points (Tsukatnaya variety, 2017, addition 20% of apples).

The highest possible balance of taste was observed with the addition of apples in the amount of 25%. Moreover, the overall taste, taste of the fruit, and the taste of syrup were rated at the level of 5 points in jam made from fruits of the Moskovskaya aromatnaya variety, regardless of the year of research, and in jam made from the Tsukatnaya variety in 2016. In 2017 taste of jam from the Tsukatnaya variety was estimated at 4.97 points, the taste of syrup was at 4.98 points, and the overall taste was at 4.98 points.
The very highly rated color characteristics of the fruit fraction and syrup also contributed to the formation of an attractive appearance of the finished product (from 4.75 to 5.0 points depending on the variety and year of research).

4. Conclusion
1. The formation of optimal sensory characteristics of jam is facilitated by post-harvest ripening of the fruits of the studied squash varieties during 2-3 months, whereby fruit pulp take on intensive orange color, pronounced sweet taste, and a pleasant aroma.
2. The studied varieties of Musky squash (Moskovskaya aromatnaya and Tsukatnaya) were grown in the Moscow region to ensure the production of high-quality sugar-canned products and in a particular jam.
3. The most attractive appearance and balanced taste of Musky squash jam were formed when 25% and 50% of water in sugar syrup was replaced with apple juice or when 15-25% apples were added.

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