PHYSICAL-CHEMICAL CHARACTERISTICS OF THE TASTE OF JAM TYPE PRODUCTS

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Abstract

The purpose of this work was to elaborate the physical-chemical method able to estimate the sweet taste degree of jam as a function of the physical-chemical properties of fruits and saccharose content of the final products. A direct correlation between physical-chemical properties such as: dry weight, pH, acidity and the sweet taste degree of the examined products has been observed. Using the equation suggested by the authors, the optimised sweet taste degree of fruit jam was equal to 16.0 – 17.5 units. Sensorial analysis of jam has demonstrated that the sweet taste degree was harmonised to the indices obtained using the equation.

Keywords: physical – chemical indices, sweet taste degree, jam, sweet jam, saccharose, acidity.

Rezumat

Scopul cercetărilor a fost elaborarea metodei fizico-chimice de apreciere a gradului de gust dulce a produselor de tip gem şi dulceaţă în funcţie de caracteristicile fizico-chimice ale fructelor şi de conţinutul de zaharoză în produsele finite. S-a constatat corelaţia directă dintre indicii fizico-chimici: conţinutul substanţei uscat solubile, pH-ul, aciditatea totală titrabilă şi gradul de gust dulce al produselor examinate. S-a demonstrat că gradul de gust dulce optimizat al gemului şi dulceţii din fructe este egal cu 16,0–17,5 unităţi, determinat cu ajutorul relaţiei deduse. Analiza senzorială a produselor de tip gem şi dulceaţă a demonstrat că gradul de gust dulce corespunde indicilor obţinuţi cu ajutorul relaţiei date.

Cuvinte cheie: indici fizico-chimici, grad de gust dulce, gem, dulceaţă, zaharoză, aciditate.

1. Introduction

The first consumer contact with the product is done by a sensorial way, and, in consequence, the sensorial properties have a primordial role in selecting and buying decision (Diaconescu and Paunescu, 1988).

Systematic researches in sensorial domain have led to the accumulation of a methodology concerning the application method of sensorial analysis in order to controll and to estimate estimation of food quality (Crutoshicova, 1988).

Laboratories focusing on improving the food sensorial estimation methods of foods have been created in scientific research institutions in USA, England, Canada, France and other countries (Fan-Iung, 1980).

The quality coefficients of the nutritional value and sensorial properties of food have been determined by the KQ method elaborated in Germany (Crutoshicova, 1988). Acording to the KQ method, the ponderability of sensorial properties and nutritional value in estimating the quality fruit food of was determined as being 60:40 (Fan-Iung, 1980).

They tried to imitate the basic functions of the nose by using physical-chemical methods and electronic devices. The result of these researches was a new type of analytical artificial system named “electronic nose”. The „electronic nose” consisted in a vapor

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analyzer which imitates the function of the human smell organ (Diaconescu and Paunescu, 2003).

One of the most important directions in estimating sensorial properties of aliments is the correlation study between physical-chemical characteristics of foods and their taste. The dependence of the sweet taste degree of natural and synthetic chemical compounds was determined following this research direction. (Corenman, 2001; Egorova, 2003).

The degree or the sweet taste power of separated chemical substances was estimated. It was accepted that a unit of sweet taste degree would manifest as a solution of 10.0 g saccharose in 100 g of water at 20°C temperature and that was estimated as 1.0 point. The sweet taste degree of different substances can be higher or lower than 1.0 point (Crutoshicova, 1988). Still, in the composition of food products there are hundreds and thousands of chemical substances with different tastes (Corenman, 2001).

The food taste as a function of chemical composition was to be estimated. But the proposed methods did not permit to determine the correlation between the taste and chemical composition of foods.

The purpose of the research was to establish a physical-chemical method for processing the sweet taste degree of the jam type products in function of physical-chemical characteristics of fruits and saccharose composition in final products.

2. Materials and Methods

Fresh fruits like cherries (variety „Early Şpanca"), plums (variety „Stanley"), saccharose and pectine strongly metoxilated, metoxilation degree 79.0% (Diaconescu and Paunescu, 2003) were used for research. In concordance with the new technology cherry and plum jam was obtained.

Both for the raw material and for jam the following parameters were determined:

- Saccharose composition by refractometry;
- Total titrable acidity and *p*H value by standardized method (Hoppe and Gaβmann, 1985).

In order to appreciate the sensorial properties numerous tastings in concordance with the rule PG 29-02-98-99, Kishinev 2000 were performed.

The experimental data were processed using the programme "Gust" made in Microsoft Excel.

3. Results and Discussion

The chemical composition and sensorial properties of plum, cherry and strawberry jam was analyzed in order to identify the physical-chemical characteristics of foods that influence the taste of products. Therefore, from all five basic tastes, it was determined that the products' taste represents a combination of sweet and sour taste.

The degree or the sweet taste power of jam depends on the presence of chemical compounds of sweet taste in the food composition, especially, of saccharose which is introduced during processing. The saccharose concentration in final products could be between 30–65 % of the total mass.

The sour taste of foods is a function of the *p*H value and the composition of organic acids: citric and malic acid. The inferior *p*H values, for example *p*H = 2.0–3.0 determine the appearance of a pronounced sour taste. On the other hand, the *p*H values depend on the dissociation degree of organic acids, which varies with the product's chemical composition.

Therefore, the jam taste can be generally presented by the expression:

$$G_{pr.} = \left(G_{sweet,} G_{sour}\right) \quad (1)$$

where: $G_{pr.}$ is the product's taste;
G_{sweet} – sweet taste degree;
G_{sour} – sour taste degree.

The estimation of sweet taste degree was done considering that saccharose is the basic substance of the jam sweet taste. The correlation between saccharose concentration and sweet taste was determined by analyzing the experimental data obtained by Hoppe and Gaβmann (1985).

The functional expression in logarithmic coordinates between sweet taste degree and saccharose concentration logarithm with a correlation coefficient $R^2 = 0.99$ was obtained:

$$\ln G_d = 0.909 \cdot \ln Z + 0.1875 \quad (2)$$

where: G_d is the sweet taste degree;
Z – saccharose concentration, %.

The equation expression (2) could be used to estimate the saccharose sweet taste degree between concentration limits of 2.7–60%.

The jam sweet taste depends on the composition of soluble solutions (SU), including the concentration of saccharose and organic acids, monoglucide composition (Hoppe and Gaβmann, 1985).

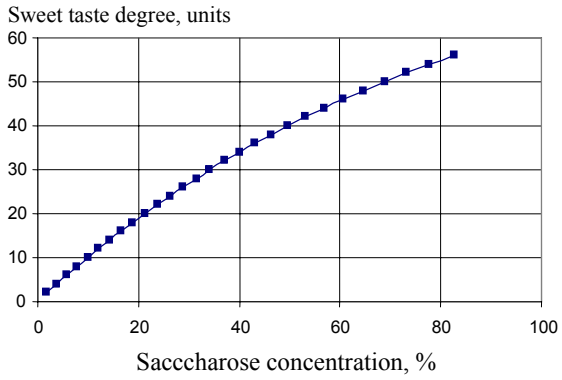

Figure 1. Sweet taste dependence on the saccharose concentration in solutions with *p*H=7.0 (After Hoppe and Gaβmann, 1985)

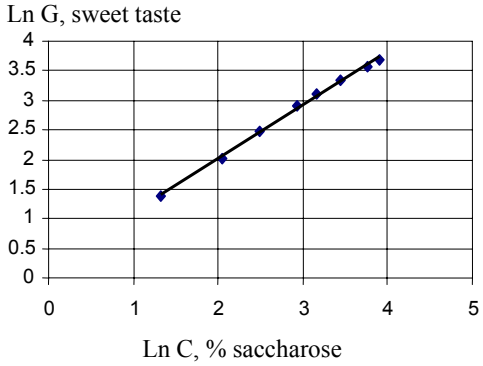

Figure 2. Correlation between sweet taste degree and saccharose concentration in solutions with *p*H = 7.0

The saccharose concentration (Z) was changed with the composition of soluble substances (SU) for the products examined in equation (2) by excluding the total composition of organic acids (SU – Ac) that have sour taste (Ac):

$$\ln G_d = 0.909 \cdot \ln(SU - Ac) + 0.1875 \quad (3)$$

The equation (3) reflects the physical-chemical characteristics.

The estimation of physical-chemical characteristics responsible for the appearance of sour taste is a complex problem. Until now, the indeces with numeric values of sour taste were not determined. In the composition of fruit products such as berries, organic acids with a variable dissociation degree and different sour taste power are present.

Citric acid was used for sensorial organoleptic estimation of the sour taste in function of etalon (Crutoshicova, 1988).

The influence of the citric acid on jam taste is prone to be estimated in the present work. The *p*H value dependence of water medium on citric acid was analyzed (Fig. 3).

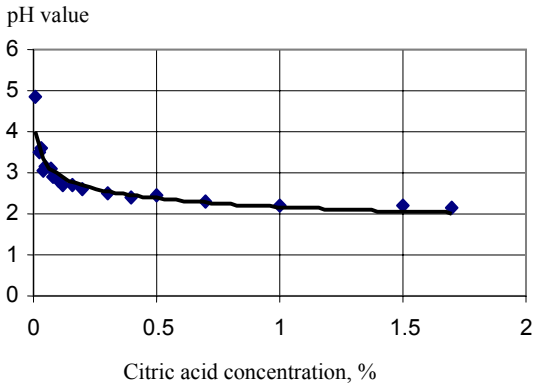

Figure 3. The *p*H value dependence on the citric acid concentration in water medium ($R^2 = 0.91$)

A functional correlation between *p*H value and citric acid concentration was found:

$$pH = 2.169 \cdot Ac^{-0.1325} \quad (4)$$

Where: *p*H is the active acidity value,
Ac – citric acid concentration, %.

Taking into account that sour taste depends on *p*H value and acids' concentration, the influence of citric acid on taste can be presented by the expression:

$$pH \cdot Ac^{-0.1325} \quad (5)$$

The sour taste coefficient was obtained from the experimental data:

$$G_k = \frac{pH \cdot Ac^{-0.1325}}{7.0} \quad (6)$$

Where: G_k is the sour taste coefficient;
*p*H – active acidity value;
Ac – citric acid concentration, %;
7.0 – *p*H value of a medium with neutral taste.

G_k coefficient has values from 0.1 to 1.0. The most pronounced sour taste corresponds to G_k = 0.1 coefficient, meanwhile a neutral taste if G_k = 1.0.

The physical-chemical characteristics that reflect jam's taste are presented by the equation (7) which is based on equations (3) and (6):

$$G_d = \frac{pH \cdot A_c^{-0.1325}}{7.0} \exp\left[0.9 \cdot \ln\left(SU - A_c\right) + 0.187\right] \quad (7)$$

Where: *p*H is the *p*H value of the product without sugar;
Ac – titrable total acidity of the product, in % or in 100 g of product;
7.0 – neutral taste values;
SU – product dry weight (soluble substances' composition), in %.

Equation (7) could be used to estimate the sweet taste degree of jam by determining the physical-chemical characteristics. The elaborated method is designated especially for products' taste prognosis as a function of physical-chemical characteristics of fruits and saccharose composition.

Pre-testing of the taste permits to determine a large variety of products by using the equation (7) and to produce jams with determined sweet taste degree.

After tasting session of jam from different fruit species, the correlation between the optimized sweet taste degree and numeric values of this taste, calculated by the expression (7) has been revealed It was demonstrated that the best taste evaluations (values between 4.5–5.0) correspond to the sweet taste degree calculated between the limits 16.0–17.5 units. The G_d index shows the sweet taste degree of the product which is equivalent to the saccharose solution with a concentration of 16.0– 17.5 %.

If the sweet taste degree of product is lower than 16.0, then the fruit jam is considered too sour. When the sweet taste degree of product is higher than 17.5, the jam is considered too sweet.

The data concerning sweet taste degree of jam fabricated in industrial conditions and experimental jam samples obtained in laboratory conditions are presented in table 1.

Table 1. Sweet taste grade of gem fabricated conforming to industrial networks and networks determined using expression (7)

No	Product name	Calculated sweet taste grade, units	SU com-posi-tion, %	Obtaining module
1	Cherry gem	23.9	65.0	Industrial
2	Plum gem	28.8	65.0	Industrial
3	Cherry gem	16.3–17.2	44.0	Experim.
4	Plum gem	17.17–17.74	35.0	Experim.

The manufactured jam presented excessive sweet taste after the tasting session estimation and the estimation of sweet taste degree by physical-chemical characteristics.

The tasting results of the jam manufactured in industrial conditions presented relatively low values (3.2–3.8) because of the excessive sweet taste and the inferior fruit taste. The calculated sweet taste degree (G_d) was in the limits of 24.8...29.2 (table 2). The sensorial quality of experimental samples manufactured by using the elaborated method was appreciated with values from 4.4 to 4.7 with an optimized sweet taste degree G_d = 16.7–18.3.

4. Conclusions

- The correlation between sweet taste degree of jam type products and saccharose composition, total acidity and *p*H value of fruits and berries was determined;

Table 2. Sensorial properties' characteristic of the industrially fabricated gem and the gem obtained by the elaborated methodology

No.	Sens. name	Plum gem	Cher gem ind.	Cher gem	Strawberry gem	Strawberry gem ind.	
1	Consist	4.6±0,4	2.8±1.1	4.1±0.5	4.06±0.6	4.5±0.5	3.4±0.42
2	Aspect	4.3±0,3	3.2±0.4	5.0±0.0	4.2±0.6	4.1±0.4	3.2±0.4
3	Smell	4.8±0,3	3.5±0.6	4.9±0.2	4.7±0.4	4.5±0.9	2.9±0.2
4	G. fruits	4.96±0,1	3.1±0.7	5.0±0.0	4.9±0.05	1.4±2.2	3.0±0.7
5	G_d	18.3	24.8	16.9	16.7	29.2	26.1
6	Gen. value	4.7±0.2	3.2±0.27	4.7±0.2	4.4±0.35	3.8±0.74	3.0±0.46

- It was demonstrated that the equation (7) could be used to estimate the sweet taste degree of jam and to determine by calculus a large variety of products with determined sweet taste;
- The researches revealed that the optimized sweet taste degree of fruit jam consists in values from 16.0 to 17.5 units and can be determined by using the equation (7);
- The sensorial analysis of jam demonstrated that the sweet taste degree corresponds to the obtained indexes by using the equation (7).
- The research in this area should continue.

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