

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The Production Technology of Diabetic Confection with Modified Carbohydrate Profile.

T.V. Savenkova*, M.V. Osipov, E.V. Kazantsev, A.A. Kochetkova, V.M. Vorobieva, I.S. Vorobieva, and T.L. Kiseleva.

Federal State Budgetary Scientific Institution "Federal Research Centre of Nutrition, Biotechnology and Food Safety (FSBSI "FRC of Nutrition, Biotechnology and Food Safety"), Moscow, Ustyinsky Passage, 2/14

ABSTRACT

Diabetes mellitus is the disease, caused by absolute or relative insulin deficiency and characterized by the carbohydrate metabolism disorder with increased amounts of glucose in the blood, as well as other metabolic disorders. Diabetes mellitus belongs to three the most common types of diseases, after cancer and diseases of cardiovascular system. Every year, the number of diseased people in the world increases by almost a half, and the causes of this disease can be the most diverse. However, no matter, what is the main factor, leading to this disease, and what is the type of diabetes, the patient can be always helped.

The work presents the production scheme of marmalade with modified carbohydrate profile with maltitol. The process parameters and the recipes were developed during the research.

Keywords: type 2 diabetes (DM2), confectionery products, maltitol, dietary therapy, marmalade, pectin.

**Corresponding author*

INTRODUCTION

The important issue in the development of confectionery industry is focused on solving the problem of new technologies implementation, to obtain competitive confectionery products, including specialized food products according to TR CU 021/2011 "On food safety" [1], which is intended for safe use of these food products by certain categories of people.

Dietary confectionery products with modified carbohydrate composition are intended for consumption by people with diabetes mellitus, people with overweight and obese [2].

Medical science says that the increase in the number of diabetes cases, cardiovascular diseases, dental caries is associated with the increased number of confectionery products based on sucrose.

Diabetes mellitus - is a chronic disease [3, 4, 5, 6, 7, 8], which is characterized by metabolic disorder, primarily carbohydrates (namely glucose), the number of patients for 2030 will exceed more than 430 million people [9, 10, 11].

Taking into account the seriousness of the problem, and the fact that increasing number of young people suffers from this disease, the creation of diabetic foods, which positive effect on the human body is confirmed by experimental and clinical studies, is the important task.

The creation of new generation confectionery products with modified carbohydrate profiles for personalized diet therapy of DM2, is the important task and is aimed to improving the quality of persons' life.

Taking into account, that consumers like not only candy, chocolate and biscuits, but marmalade [12, 13], the complex of works on modification of the marmalade carbohydrate profile was carried out.

The purpose of the research – is to develop model samples of jelly marmalade with modified carbohydrate profile.

MATERIALS AND METHODS

The objects of the research are modeling products - marmalade jelly mold and marmalade fruit-berry with modified carbohydrate profile. Maltitol is included in marmalade as artificial sweetener.

- Marmalade with artificial sweetener maltitol with dry sublimated juice "Cranberry" and sublimated beet juice - sample №1.
- Marmalade jelly-fruit with artificial sweetener maltitol (with applesauce) - sample №2.

For the production of marmalade the following products were used: maltitol, allowed for use in food production, in accordance with the established procedure TR CU 029/2012 [14]; apple amidated low-esterified pectin [15] was used to create the jelly consistency of marmalade, according to technical documentation, or foreign-made, allowed for production of food products in accordance with the established procedure TR CU 029/2012; ascorbic acid in accordance with GOST 4815-76; juice dry sublimated "Cranberry" in accordance with GOST 32101-2013 "Canned food. Juice products. Fruit juices of direct pressing. General technical conditions" [16]; beet sublimated juice, according to GOST 54682-2011 "Semi-finished products. Fillers fruit and vegetable. General technical conditions" [17]; applesauce without sugar, in accordance with TU 9163-065-18008485-08 [18]; sodium lactate, according to GOST R 31642-2012 [19], potable water in accordance with Sanitary Rules and Regulations 2.1.4.1074-01 [20]. The fortification of products with biologically active substances, having hypoglycemic action, was carried out by means of adding of innovative ingredients in the recipes - blueberry leaf extract and soluble dietary fibers. All raw materials, used for the production of marmalade [21, 22], met the requirements of TR CU 021/2011 and were accompanied by documents, certifying the quality and safety.

The investigation of organoleptic characteristics of marmalade was carried out by the method of profilograms constructing. The determination of the moisture weight fraction was held in accordance with GOST 5900-73 "The methods for determination of the weight fraction of moisture and dry matters" [23]. The

determination of total acidity was carried out in accordance with GOST 5898-87 "The methods for determination of acidity and alkalinity" [24]. The weight fraction of fruit raw material was determined in accordance with "The methodology for determination of weight fraction of fruit raw material in confectionery products, Measurement procedure 36-00334675-2013, developed in Federal State Budgetary Scientific Institution of All-Russian Research and Development Institute for Cable Industry by the method of capillary electrophoresis on the equipment Prince 770-CEC [25]. The determination of marmalade strength was carried out using the method of Valenta.

THE PRODUCTION SCHEME OF FRUIT-JELLY MARMALADE

Maltitol was used for the production of marmalade as artificial sweetener. Its characteristic is shown in Table 1.

Table - 1 Comparative characteristics of natural and synthetic sweeteners

Index	Maltitol	Sucrose
Index E	E 965	GOST 21-94
According to the method of producing: natural/synthetic	Synthetic, obtained by hydrogenation of maltose from starch	Natural
The degree of sweetness: extensional/intensive	extensional	extensional
Sweetness (sucrose = 1)	0,7-0,9	1,0
Taste profile	Pleasant sweet, like sugar, but with little "cooling" effect	Intensively sweet
Caloric value/100g	210	387
The impact on the level of sugar in blood	It does not cause a sharp rise of glucose level in blood. It is used without any restrictions.	Excluded. Dramatically increases the level of glucose in blood.

The table shows, that the maltitol has lower sweetness, compared with sucrose, and absorbed more slowly, so that the glucose level in blood increases gradually, not extreme, that is especially important for the people with diabetes of the first and the second types. The samples of marmalade was developed according to the relevant recipes.

The technological scheme of jelly-fruit marmalade production was developed (Figure 1).

Technological production of jelly-fruit marmalade consists of the following stages:

1. Preparation of raw materials and semi-finished products for production.
2. Preparation of maltitol syrup, pectin or pectin-sugar syrup.
3. Preparation of marmalade mass.
4. Molding and gelation of marmalade mass.
5. Delivering marmalade from molds, and coating its surface with maltitol or sugar.
6. Drying and cooling of marmalade
7. Packaging

Developed samples of marmalade were studied comprehensively, including physico-chemical and organoleptic evaluation of quality, with the measurement of structural and mechanical properties. Physical and chemical characteristics of marmalade samples are presented in Table 2.

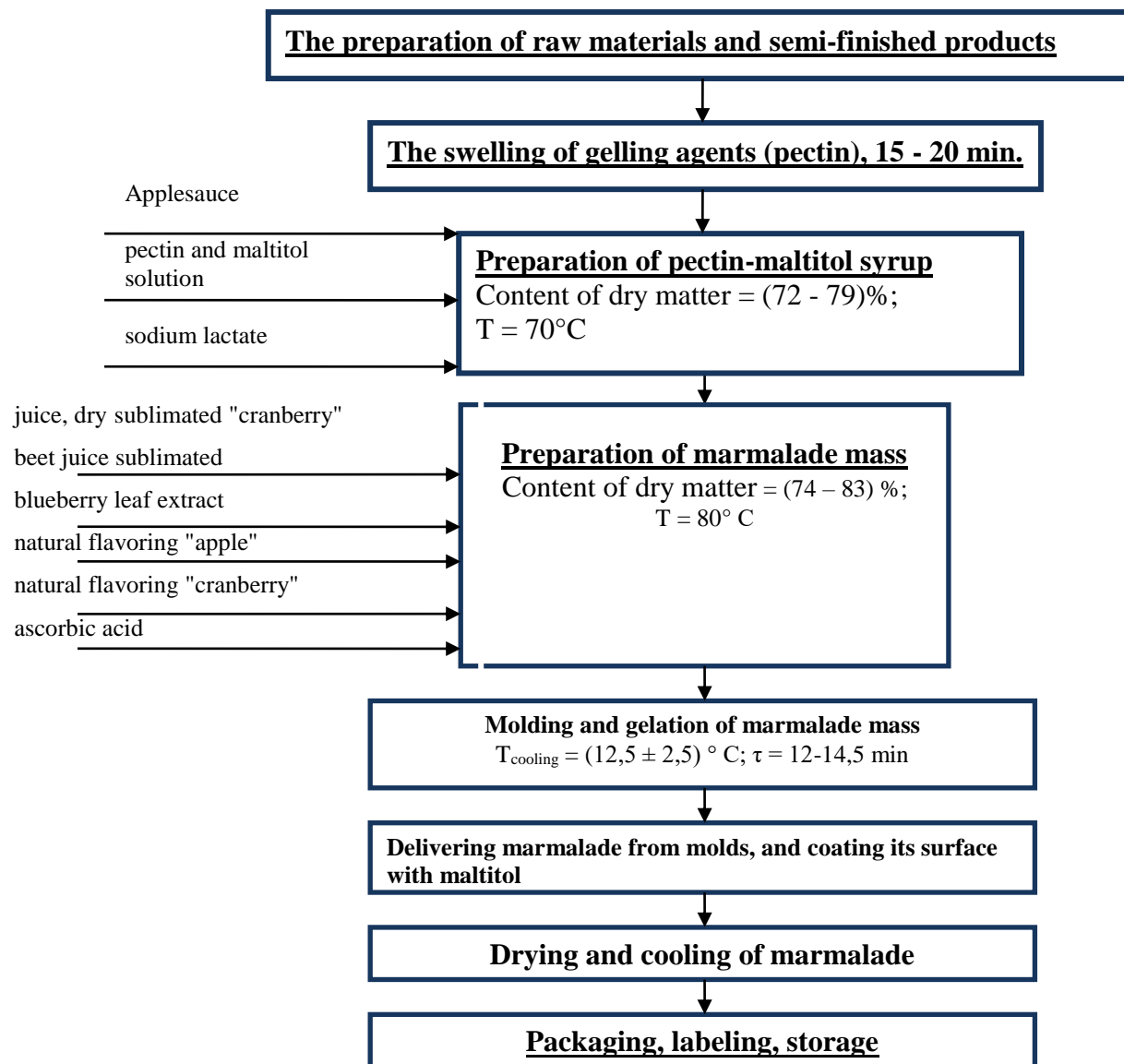


Fig. (1). The technological scheme of jelly-fruit marmalade production.

Table 2 - Results of the study of physical and chemical indicators of marmalade

Item No	Defined indexes	The results of the research	GOST 6442-2014	Units of measurements	Normative documents for the research methods
Jelly marmalade with sublimated dry juice "Cranberry" and sublimated beet juice with the artificial sweetener maltitol, (recipe №1)					
1	Weight fraction of moisture	23,0	No more than 15-24	%	GOST 5900-73
2	Weight fraction of dry matters	77	-	%	GOST 5900-73
3	Total acidity	19,0	7,5 – 22,5	degree	GOST 5898-87
4	Weight fraction of fruit raw materials	14,3	-	%	Measurement procedure 39-00334675-2014

Jelly - fruit marmalade with artificial sweetener maltitol, (with applesauce, recipe №2)					
1	Weight fraction of moisture	17,0	No more than 15-23	%	GOST 5900-73
2	Weight fraction of dry matters	83	-	%	GOST 5900-73
3	Total acidity	19,6	7,5 – 22,5	degree	GOST 5898-87
4	Weight fraction of fruit raw materials	15,1	Not less than 15 %	%	Measurement procedure 39-00334675-2014

The researches showed, that marmalade samples, according to all indexes, met the requirements of GOST 6442-89 "Marmalade. Technical requirements".

THE INVESTIGATION OF MARMALADE ORGANOLEPTIC CHARACTERISTICS BY THE METHOD OF PROFILOGRAM CONSTRUCTION

Comparative analysis of organoleptic characteristics of marmalade with maltitol, according to the indexes, regulated by GOST 6442-89 "Marmalade. Specifications", is shown in Table 3.

Table 3 - Organoleptic characteristics of marmalade

Indexes, according to GOST 6442	Characteristics	
	Sample №1	Sample №2
Color	Light - burgundy, flat	Light yellow, flat
Shape	The shape is correct with a clear outline, without deformation	The shape is correct with a clear outline, without deformation
Surface	Proportionally covered with maltitol, small crystalline crust	Proportionally covered with maltitol, small crystalline crust
Consistency	Jelly	Jelly
Taste and smell	Sweet and sour, without foreign tastes and smell	Less sweet and sour, without foreign tastes and smell

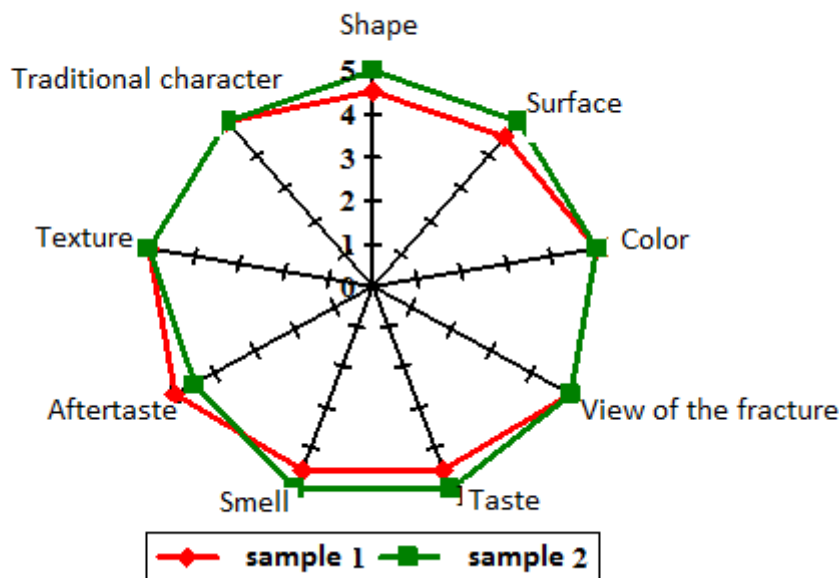
Sensory evaluation was carried out on the basis of marmalade samples tasting for the following indicators: physical form (shape, surface, and color), view of the fracture, smell, taste, aftertaste, texture *, traditional character **, using 5-point system with the maximum possible number of points 45.

* Texture – is the macrostructure of the product, i.e. the system of mutual arrangement of its structural elements, organoleptically characterized by complex visual, auditory and tactile sensations, which arise when chewing the product.

** Traditional character - characterizes the continuity degree of research product indexes, in relation to accepted analogue - traditional marmalade, produced according to GOST 6442 and served as a guarantee of not misleading the consumers to the expected properties of the product.

The analysis of statistical processing of tasting sheets, defined the following results for the quality levels of products:

- Marmalade with artificial sweetener maltitol, with dry sublimated juice "Cranberry" and sublimated beet juice - sample №1 - 43 points.
- Jelly- fruit marmalade with the artificial sweetener maltitol (with applesauce) - sample №2 - 44.5 points. The distribution of points for each descriptor of organoleptic characteristics is shown in Figure 2.



On the basis of conducted sensory evaluation, obtained marmalade samples are characterized by high organoleptic characteristics, typical for high-quality marmalade.

THE DETERMINATION OF STRENGTH OF JELLY MARMALADE SAMPLES BY THE METHOD OF VALENTA

Table 4 – The results of study of physical and chemical characteristics of marmalade

Index	Recipe №1	Recipe №2	Recipe №1	Recipe №2	Normative documents for the research methods
	With maltitol		With sugar		
The time of jelly formation, min.	6,4	4,3	4,0	4,0	-
The temperature of jelly formation, °C	33,0	33,0	33,0	39,0	-
The strength of jelly, according to Valenta method, g	493,6	1251,0	837,0	1326,0	GOST 8756.12-91

The values of structural and mechanical properties, shown in Table 4, characterizing the strength and elastic-plastic properties of jelly products, indicate that the samples of marmalade have homogeneous structure, typical for the traditional, jelly mold marmalade.

DEDUCTIONS

Conducted studies have shown, that the quality indicators of marmalade model samples, according to all indicators, meet the requirements of GOST 6442-2014 "Marmalade. Technical requirements".

On the basis of reasoned choice of ingredients, the recipes and technology of model marmalade samples, the technological process parameters were developed.

CONCLUSION

Thus, in this research we developed the recipes and technology of model marmalade samples. We also developed the parameters of technological process to ensure the best quality characteristics of the finished product, that allowed to produce the experimental samples of marmalade with modified carbohydrate profile.

Developed marmalade samples are the diabetic products. Their production does not require time-consuming and longstanding stages of technological process; they do not contain sucrose in their composition and have harmonious combination of organoleptic characteristics, corresponding to physicochemical characteristics and good microstructure.

This production technology of jelly-fruit marmalade with modified carbohydrate profile can be widely applied for solving acute problem of diabetes.

ACKNOWLEDGEMENTS

The work was performed by means of Russian Science Foundation grant. (Project №14-36-00041).

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