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FOOD HYDROCOLLOIDS IN FRUIT PRODUCTS

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Abstract

Food hydrocolloids are a new application kind in production of food products, which are used to perform certain functions. Food hydrocolloids open a lot of different possibilities in dessert production. These polysaccharides make new specific products on fruit basis and improve existing traditional products according to customer needs.

On the basis of worked out functional analysis of hydrocolloids, it is possible to optimize regulation possibilities of heat processes for a particular kind of fruits. Some desserts need secondary heat treatment to increase shelf-life, others – application of low temperature. The research is related to application possibilities of the current and new hydrocolloids, which are not yet used in food industry. It will enable to solve problems related to storage and improve texture of the product. Usage possibilities of fresh and frozen raw materials are being compared during the research.

Key words: *hydrocolloids, desserts, pectin, gel agents.*

1.INTRODUCTION

Imortance of fruit and vegetable consumption in a healthy nutrition is emphasized in the Commission's White Paper in relation to nutrition and health issues. During the last years fruit and vegetable consumption in the European Union decreases. Besides the situation among children is particularly alarming. The youth's nutrition has changed essentially and fruit and vegetable consumption is considerably lower than it used to be before.

American and British researhers consider that in case fruits and vegetables prevail in the diet, possibility to fall ill with cardiovascular diseases is reduced for 40%. In Latvia consumption of fruits sharply fluctuates depending on the season. In order to prevent their seasonal nature in nutrition and to provide them all the year round, preservation has to be used. Nutritionists consider freezing as the best kind of preservation, because their biological value and taste are maintained best of all.

In the raw state most of the foodstuffs are a good source of vitamins, mineral substances and fiber. As consumer's lifestyle nowadays has changed radically, the tense rhythm of life makes to choose food, which has to be little treated. This era is characteristic with extensive spreading of artificial food. Several thousands of different substances are added to food in total.

Enlargement of frozen product volume, particularly fruits and berries, expansion of their assortment is one of the ways how to solve problems of valuable nutrition, in order to overcome their seasonal nature and to provide inhabitants with biologically active substances all the year round. Development of theoretical, practical and methodical background in preserving fruits and berries disclose the mutual connection and conditionality of their quality indices. Preparation of half-finished products of high readiness is connected with maintenance of natural product properties, development of products ready

for consumption, expandability of different marketing potentialities, which are connected with application of advanced storage and packaging methods and materials.

Comparatively few researches have been carried out about influence of freezing on the quality of further processing products of fruits and berries (Kampuse S, 20003). Significant factor is suitability of cultivars to freezing, as well as impact of freezing on their processing products. Comparison and optimization of theoretical and experimental thawing models will help to explain physical changes of technological process, which are connected with optimization potentialities of sensory indices. Use of additional substances related to the solidity of the product play an important role in the research. There is little information about the impact of foam-ability rate of products on foam stability and ageing. Comparative researches about freezing impact on natural properties of particular components will require a lot of work; therefore changes of structure-mechanical properties of the product in every stage of the process will have great significance.

2.MATERIALS AND METHODS

Research object: fresh and frozen berries grown in Latvia. Raspberries, red currants and black currants were used in the research. Specific cultivars were chosen with already stated chemical content. Actual berries freezing temperature was -25ºC ... -30ºC. The freezing process was intensified by decreasing the thickness of the product layer. It proved that the layer thickness must not exceed 60 mm.

Texture of the product is more physiological or sensor character than physical property. Characterisation of texture commonly falls into two main groups, based on sensory and instrumental methods of analysis. Sensory analysis includes use of the senses of smell, taste, sound and touch. Evaluation of food - by touch includes the use of the fingers, as well as the lips, tongue, palate and teeth in the mouth. As would be expected, sensory methods of analysis are subject to wide variability, though this variability can be reduced by using trained assessors. Another reason for instrumental analysis may be that often changes in ingredient levels cause several simultaneous changes in product characteristics. Some of these changes are difficult to mask and thus tend to make sensory analysis difficult. Therefore a main goal of many texture studies is to devise one or more mechanical tests with the capacity to replace human sensory evaluation as a tool to evaluate texture.

Scientific Texture Analysis provides quantifiable, repeatable and accurate data on the physical properties of food. It is now an established procedure in research, and a valuable tool in the quest for improved quality control methods. Measurements that yield both fundamental and empirical product characteristics are well developed and wide ranging imitative test procedures and are becoming increasingly important.

Texture Analysers are used to measure many properties, such as hardness, brittleness, fracturability, adhesiveness, elasticity, bloom strength etc, on a vast range of products. Texture Analyzer is by far the most popular instrument worldwide for testing the physical properties of gels and gel like materials. The TA.XT2*i* 5 kilo model for gels has a force sensitivity of 0.1 gram (0.1 bloom number), and a distance sensitivity of 0.025 mm. The TA.XTPlus has a distance sensitivity of 0.001 mm. It is perfect for measuring bloom, rupture distance and force and other qualities in gels, pectin, agars, colloids, surimi as well as stabilizers, gums and additives. Within Europe, it has been practiced to test Bloom gel strength of gelatin according to the conditions and procedure described in BS757:1975 (Methods for sampling and testing gelatin).

It is sometimes preferable to use instrumental methods of assessing texture rather than sensory analysis because they can be carried out under more strictly defined and controlled conditions. Furthermore, problems of experimental variability are more likely to be caused by sample

heterogeneity than by instrumental imprecision. (Gregson C. et al., 1999) Texture of the product is more physiological or sensor character than physical property. Therefore texture credibly can be estimated by sensory evaluation methods, though they are very expensive and time-consuming. They are replaced by instrumental methods by which it is possible to measure the most important product properties, which are determinative in formation of sensory indices.

Texture Profile Analysis is based on compression of food product piece (lump size) twice at a time as if imitating movement of jaw.

The most important attribute of gelatin is its gel strength when determined by the standard method. This is the force in grams required to press a 12.5 mm diameter plunger 4 mm into 112 g of a standard gelatin gel at 10°C. Several penetrometer type instruments have been adapted to determine Bloom Strength. (Cole et al., 2000)

A frequent question is how to substitute gelatin of one Bloom Strength for a gelatin of another. As a guide one can say:

$$C \times B^{½} = k \quad (24)$$

$$\text{or} \qquad C_1(B_1)^{½} \div (B_2)^{½} = C_2$$

Where C = concentration, B = Bloom Strength and k = constant, however, there are other considerations besides gel strength which can invalidate such a substitution calculation. For example, in a gummy formulation, the texture using 250 Bloom gelatin is far shorter than when 180 Bloom gelatin is used.

3.RESULTS AND DISCUSSION

During the last decades the issue of decreasing losses of agricultural production has obtained significance of global character. Natural losses necessarily arise just in products, in which life processes, mainly respiration, continue during storage. Technological treatment and storage of food products is connected with the change of heat rates and holding of products for certain time at fixed temperature. It is connected with heat transfer modes, which correct conformity with laws is one of the kinds, how to increase the quality of produced output and decrease its prime cost.

At present there is great interest about food products which could meet also the future requirements. These products are characteristic by the fact that they naturally incorporate in the daily diet and can be consumed without essential overdose hazard, they favourably influence important functions of the body. Most often these new products are developed on the base of plant raw materials. These products are not much researhed, cultivars with high content of antocians, flavonoids, carotonoids and ascorbic acid are not selected.

In order to optimize humans' health and decrease emergence of diseases caused by food, new, food related strategies are necessary, which are connected with a link between nutrition and metabolism. The high biological value of the chosen foodstuffs is a significant pre-condition for improving nutritional value of the new product. To create a product with desirable properties it is planned to elaborate evaluation of scientifically reasoned and experimentally tested critical points of all stages of the process. Many natural products are changed though in most cases texture of natural products is lost. Example of processed products is also jelly. In this product group there are great possibilities to combine raw materials of particular quality in such quantities and proportions enabling to obtain the

desirable texture of the product by adding the necessary food additives. Texture is an important attribute in that it affects processing and handling, influences habits, and affects shelf-life and consumer acceptance of products.

In order to estimate the desirable texture of the product in the research gelatin of different concentrations was added to the fruit mass. Sugar was used as taste improver. Texture changes were analyzed in the research for the product without sugar or product with sugar added. Fruit mass was heat treated in order to obtain homogeneous consistency. Raised gelatin of different concentrations was added to the mass. Sugar and gelatin concentrations per 100 g of the researched product are shown in the table.

Table 1

Gelatin and sugar content in jellies

Jelly	**Gelatin (g)**	**Sugar (g)**
1.	30	0
2.	35	0
3.	40	0
4.	45	0
5.	30	15
6.	35	15
7.	40	15
8.	45	15

The results of the research indicate that concentration of gelatin content influences the texture of the product. Analyses of the product solidity show disparities in products with sugar added and products without sugar.

Alternative hypothesis is accepted with 99% probability ($p<0.0001$) – the meen of the fourth index of samples 1 - 4 is less than the meen index of samples 5 - 8.

It is indicated by the t-test. Though taking into consideration that there is quite remarkable dispersion in the group of samples 5 - 8 and measurement data of the samples 1 - 4 fully incorporate into the dispersion interval of the samples 5 - 8, then the question is about the impact of the substance.

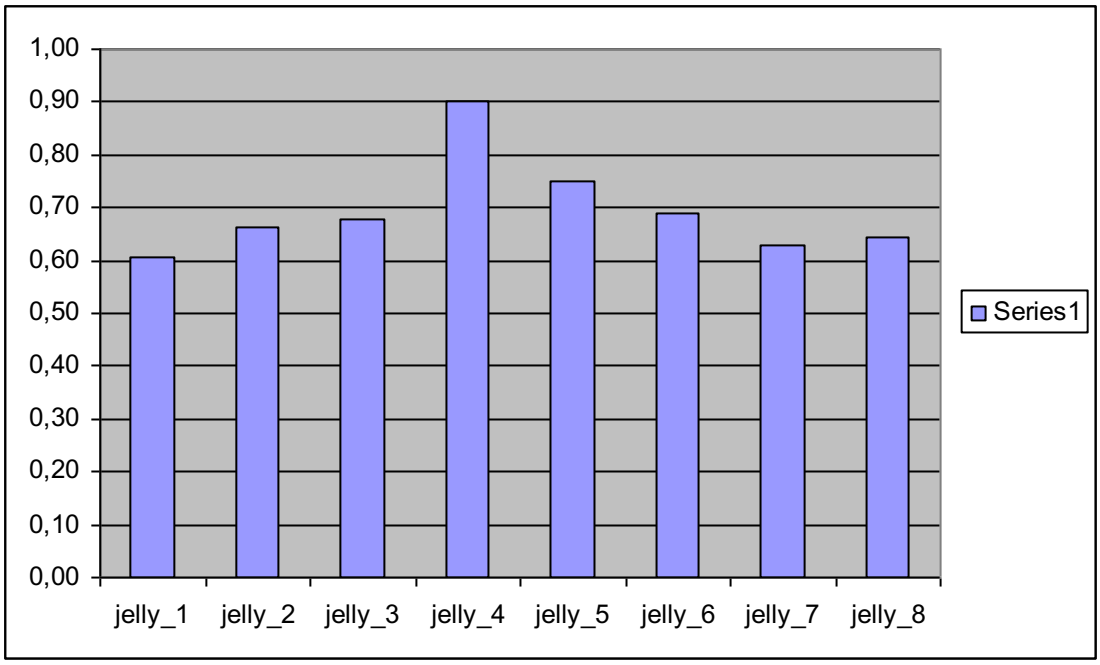


Fig. 1. Impact of the substance in jellies

By adding not only gelatin but also sugar to the fruit mass, solidity of the product decreases. Whereas for the mass with only gelatin added firmness of the product increases by increasing gelatin concentration. The results indicate that the best solidity of the product is gained with only gelatin added of concentration 45g/100g of fruit mass.

Very many food additives providing texture of food products are available; starches and modified starches form about 82% of this quantity (Vincent, 1986). Some of the texture forming substances is necessary in a very few quantity.

Preserved products, products undergone strong heat treatment and the cleaned ones are characterized by low content of vitamins, need a lot of energy from the body and pollute the body. Choice of product treatment methods, maximal maintenance of the product natural properties is the main pre-condition in production of new products. In cooking heat treatment takes up to 30% in average from the total working time spent, most of the time is spent for pre-treatment of the raw material. This is the stage, which includes provisions for further efficiency improvement. One of the solutions is to prepare half-finished products of high readiness. We propose to use freezing by which long –term storage of half –finished products is possible with minimal decrease of quality (Laszio P., Domogyi et al., 1996). However long–term storage can create natural weight loss, which is not favorable as outer appearance of preparation and consistency of product change. Experiments show that weight losses are observed during freezing, as well as during storage.

Good jelly formers are obtained from seaweeds. Agar and agaroid like gelatin form jelly already at 1% concentration. Although at higher temperature - above 70ºC and also under the influence of acid it looses jellying properties. Widely applied gelatin was used in researches as it is more studied. Gelatin is an amphoteric protein with isoionic point between 5 and 9 depending on raw material and method of manufacture. Like its parent protein, collagen, it is unique in that it contains 14% hydroxyproline, 16 % proline and 26 % glycine. The only other animal product containing hydroxyproline is elastin and

then at a very much lower concentration, so hydroxyproline is used to determine the collagen or gelatin content of foods. In brief, the protein is made up of peptide triplets, glycine - X - Y, where X and Y can be any one of the amino acids but proline has a preference for the X position and hydroxyproline the Y position. Approximately 1050 amino acids produce an alpha-chain with the left-handed proline helix conformation. Collagen exists in many different forms but gelatin is only derived from sources rich in Type I collagen which contains no cystine, however, hide or skin contains some Type III collagen which can be the source of traces of the traces of cystine found in some gelatins. Although Type I collagen contains no cystine, the alpha procollagen chains excreted by the cell do contain cystine at the C terminal end of the protein which is thought to be the site of assembly of 3 alpha-chains. The three chains then spontaneously coil together, zipper fashion, to form a right-handed helix. After spontaneous helix formation, cross links between chains are formed in the region of the N terminal telopeptides (globular tail portion of the chains) and then the telopeptides (containing the cystine and tyrosine of pro-collagen) are shed leaving the rod-like ca. 3150 amino acid containing triple helix . These collagen rods assemble together with a quarter-stagger to form the collagen fibre and the fibres are stabilised by further cross-links.

If a gelled jelly is frozen, the product will suffer from syneresis and on thawing the clear jelly will disintegrate with much exuded water. However, if water containing 0.5 % gelatin is frozen, the water will freeze as millions of small discrete crystals, instead of forming a single solid block of ice. This effect is most desirable in "ice lollies" and is also used in ice cream manufacture to obtain a smooth product with small ice crystals and also to ensure that any lactose precipitates as fine crystals avoiding the development of graininess with time.

To minimise loss of gel strength and viscosity with time, the pH of the solution should be in the range 5 to 7 and the temperature should be kept as low as possible, consistent with the avoidance of gelation and the suitability of the solution viscosity to the particular application. Often the cause of degradation or hydrolysis of gelatin in solution is microbial proliferation, so gelatin solutions should not be stored for longer than is absolutely necessary, and after addition of the acid to confectionery formulations, the solution should be used and cooled/gelled with minimal delays. Solution pH (1%) is usually about pH 5 but can vary considerably. At this pH the viscosity of Type B gelatin is minimal and the gel strength is maximal, hence from the manufacturers point of view it is advantageous to manufacture gelatin at this pH. However, due to the strong buffering capacity of gelatin this pH may not be the most advantageous for the customer.(Barbosa-Canovas, G., 2000)

The new developed product – frozen fruit and berry half-finished products of high readiness – will increase the range of existent products. Recently more and more innovations enter the manufacture of food products and one of them is food hydrocolloids. They are food additives, which are used to carry out certain functions of food products. At present one of the branches of food production, where there are many unused applications of food hydrocolloids, is fruit and vegetable processing, which by all means occupies a remarkable part of food industry.

Range of goods or services will increase related to development of many more appealing new products concerning texture and flavors. At the same time it would provide the consumer with a healthy product, because hydrocolloids are nature polymers with certain functions.

Fruit jelly is a kind of half-finished product little used in practice, which is connected with the limited proportion of resources and equipments. Freezing before boiling does not essentially influence structure of berries jelly though substantially reduces rate of berries sweetness, which has to be considered in the new technology. Storage of frozen half-finished products of high readiness in a frozen state can significantly change the quality between kind of using fresh and frozen berries. Influence of raw materials on the quality of half-finished product can be estimated during the whole

storage time. (Skrede G., 1996) Quality changes during thawing are connected with diversification possibilities of certain factors of dense and loose layer. For the production of the existent product usually fruit and berry juices and purees are used, which have already been heat treated before being used in further technological process. While culinary treatment of fruit, nutrient losses are inevitable. Development of the new product foresees reduction of these losses to the utmost already at the initial stage of the process. Application of thickeners and foam stable components, which were not available in manufacture of conventional ready-made products, will enable to make a product with desirable good quality properties.

The research shows that the influence of the temperature has to be differentiated – if one can ignore the influence of the temperature on the thermal capacity and thermal conductivity of fresh fruit, then regarding the enthalpy of frozen products, the temperature is one of the main factors.

CONCLUSIONS

1. One of the branches of food production, where there are many unused applications of food hydrocolloids, is fruit processing, which by all means occupies a remarkable part of food industry in Latvia.
2. The stability of gelatin in solution depends on temperature and pH. Generally, to minimise loss of gel strength and viscosity with time, the pH of the solution should be in the range 5 to 7 and the temperature should be kept as low as possible, consistent with the avoidance of gelatin and the suitability of the solution viscosity to the particular application.
3. Development of the new product foresees reduction of these losses to the utmost already at the initial stage of the process, what is connected with correct preparation and storage of raw materials.
4. The results of the research indicate that concentration of the gelatine content influences the texture of the product. Further researches are necessary for the optimum usage of the product texture in order to enable use of fresh and frozen berries.

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