

Effect of hydrocolloids on the stability of fruit fillings

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ABSTRACT

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Introduction. For extend the assortment and improve the nutritional value of co-extrusion products, as filler was developed fruit stuffings.

Material and methods. Assessments of the stuffings were carried using the "polygon" method. by the following indexes: color, clarity, taste, smell, texture and behavior in the hull. For research of stuffing's properties and behavior, namely its water-retaining capacity, it has been determined the content of DM in the series of stuffings based on mixture of pectin and modified starch, during the storage.

Results and methods. Based on the received date, we should select a group of stuffings in which the range of moisture is only 4.5 - 5.6%. Better results showed stuffing with pectin and modified starch Emjel (№4) and stuffings based on apple juice and pectin. In other samples of stuffing the values are found in the range from 6,5 to 11,5% of dry matters during the storage.

Common quality of indicators, calculated as the area of the pentagram, made it possible to determine the optimal samples of stuffings. According to the results of all research of the series of stuffings, better results showed stuffing with pectin and modified starch Emjel and stuffings based on apple juice, for using in the co-extrusion product.

Introduction

Products of food concentrate industry occupy a significant place in the food market. Fast food and ready-to-eat foods are very popular. Because, time for preparation of these products is minimized or missing. It should be noted about the segment of products made by extrusion. It's universal, productive and cost-effective method of producing the finished product. Extrusion process allows using of a wide range of materials, and introduction of various additives and fillers (BAS, pastry fillings, etc.). Nowadays, almost all co-extrusion products contain fatty confectionery stuffing. Therefore, it is proposed to add as filler the fruit stuffing for the purpose expansion of assortment and improvement of the nutritional value of co-extrusion products [2].

Fruit and berries filler should have a high water-retaining capacity to prevent interaction with the hull of co-extrusion product. Most often, co-extrusion product contains the fatty stuffings, since they have necessary technological properties. In particular, low moisture content, at 4-6%. Upon cooling, fatty stuffing goes to the solid state, which makes it impossible for the migration of moisture from the stuffing to the hull of the product, under their contact. In the case with fruit filling situation is different, and it is connected with the use of raw materials from which it is prepared.

Since the content of dry matter (DM) of apple puree is only 10%, and which is often the basis for the stuffing [2]. The difference between moisture content of prepared stuffing and hull of co-extrusion product is large, within 17–25%. The result is the migration of moisture, leading to softening, loss of crunch, forms, and other negative changes. For "binding" free moisture and retaining it in this form for a long time, it was proposed to use in the recipe of fruit stuffing, stabilizing and water-retaining agents – highly-esterified pectin and modified starch [1, 6].

Material and methods

The object of research is the fruit filling based on compositions of pectin and modified starches for production of co-extrusion products. There were used the following hydrocolloids during the development of recipes of fruit stuffing:

1. Highly esterified apple pectin [1]; —
2. Modified starch [6]:
 - Flogel-60 – acid-modified and gelling starch;
 - National Frigex nV – hydroxypropyl distarch phosphate from tapioca starch;
 - Emjel EP-300 – pre-gelatinized acetylated distarch phosphate from potato starch;
 - ULTRA-TEX –hydroxypropyl distarch phosphate from tapioca starch;
 - THERMFLO – hydroxypropyl-distarch phosphate from waxy maize starch.

Determination of dry matter content in the samples of stuffing was carried by refractometric method, during 4 days.

To identify and clarify the causes of migration of free water and to study the properties and interactions between stuffing and extrudate has been prepared the control sample - fruit stuffing according to the recipe shown in (Table 1).

This staffing is often used in confectionery and bakery industries [2].

Table 1
Recipe of control sample of fruit stuffing based on apple puree (per 1,000 kg of finished product, mass fraction of DM 65%)

Ingredient	Weight, kg	Wet, %	Dry matters	
			%	kg
Sugar	433,42	0,15	99,85	432,77
Treacle	216,73	22	78	169,05
Apple puree	422	90	10	42,2
Citric acid	15,35	50	50	7,7
Water	100	—	—	—
Total	1187,5			651,72

Research of fruit stuffings was carried out with organoleptic evaluation.

Experimental samples were prepared with substitution of apple puree for pectin (in powder form), and water for juice in the recipe. Boiling lasted to the content of DM $71 \pm 2\%$ [3]. In order to investigate the behavior of stuffing was used extrudaty with moisture content of 4–6%.

For research of stuffing's properties and behavior, namely its water-retaining capacity, it has been determined the content of DM in the series of stuffings based on mixture of pectin and modified starch, during the storage. Determinations were conducted in the stuffing of the open storage and inside the extrudates.

Under determining of the best model among the prepared stuffings, their comparative organoleptic characteristics have been carried out. Assessment of the advantages and disadvantages of different stuffings were carried using the "polygon" method, by the following indexes: color, clarity, taste, smell, texture and behavior in the hull. Indexes were evaluated by a ten score scale.

Results and discussion

Parameters of the control sample don't meet the requirements that would allow the possibility to use it in co-extrusion products. The consistence of stuffing is pasty, thick and doesn't form a strong gelatinous structure. This is due to insufficient amount of pectin or low quality of apple puree. In addition, the stuffing is opaque, turbid and brown. DM content in the stuffing is much lower than that of recommended.

During the boiling to a higher content of DM the temperature increases (103-105°C), that leads to decrease of quality coefficient: filling gets dark, flavor of gets burnt sugar appears, taste is worse. The boiling process is complicated by the presence of dietary fiber and other coarse particles of the apple puree.

Recipes of the experimental samples of stuffings are presented in Table 2.

Recipes of the experimental samples of stuffing

Table 2

Sample	Ingredient							
	Sugar, g	Treacle, g	Apple pectin, g	Modified starch, g	Citric acid, g	Water, ml	Apple juice, ml	Glycerin, ml
1	100	20	2	—	1,5	100	—	—
2	65	30	1	8 (Flogel)	1	80	—	—
3	65	30	1	5 (N.Frigex)	1	80	—	—
4	65	30	1	5 (Emjel)	1	80	—	—
5	65	30	1	5 (UltraTex)	1	80	—	—
6	65	30	1	5 (ThermFlo)	1	80	—	—
7	65	30	1	—	1	—	80	—
8	65	—	1	—	1	—	80	—
9	65	—	1	3 (Flogel)	1	—	80	—
10	65	—	1	6 (Flogel)	1	—	80	—
11	65	—	1	—	1	—	80	3
12	65	—	1	3 (Flogel)	1	—	80	5

Investigation of the filling samples №1, №2 (Table 2).

The moisture is exuded by both samples of filling. When the filling is kept in the container, the sample with starch loses more moisture than another one [4]. The filling sample with pectin keeps the level of water content constant. When kept in corpus, both samples lose moisture almost with the same speed, though the loss in the filling with starch is a little bit more intensive.

Investigation of the filling samples №3, №4 (Table 2).

The analyses of these two fillings showed the reduction of moisture in both samples. When the filling is kept in the container, the sample with National Frigex starch loses moisture more intensively [4, 6]. When kept in corpuses, both samples lose moisture almost with the same speed, though the loss in the filling with National Frigex starch is a little bit more intensive.

Investigation of the filling samples №5, №6 (Table 2).

The moisture is lost by both filling samples. When the filling is kept in the container, the sample with THERMFLO starch loses moisture more intensively. That can be explained by the process of starch retrogradation and the instability of the formed structure. The same is true when the filling is put in corpus. The water content in the filling sample with Ultra-tex starch is reduced less intensively both in the container and in the corpuses [5].

Investigation of the filling samples №7, №8 (Table 2).

When kept in the container, the filling doesn't lose moisture. The changes were recorded in filling samples kept in corpuses after drying and under ordinary conditions. When kept in corpuses, both samples lose moisture almost with the same speed. When dried, the moisture from corpus is taken away and it becomes fragile and crumbly. After drying, the intensity of moisture loss is lower than in the samples without drying. In the course of time the corpus becomes a bit more moistured and the sample is not fragile and crumbly any longer.

Investigation of the filling samples №9, №10 (Table 2).

The next samples both contained the mixture of pectin and Flogel-60 starch, but in different proportions. When investigating the moisture loss, it was discovered that the amplification of the starch amount doesn't affect largely the speed of water loss. Both samples show stability when stored in containers and undergo some changes when kept in corpuses after drying.

Investigation of the filling samples №11, №12 (Table 2).

The filling also contains free moisture, so it was suggested using glycerin alcohol as an additional water-retaining agent. It was noticed that glycerin slowed down the speed of moisture loss. When the whole corpuses were dried, the moisture almost didn't exude so that the corpus with filling remained crusty and crumbly for a long period of time. It can be claimed that extra convective drying and an additional water-retaining agent glycerin make the water content of filling the most stable.

The amount of moisture that extracted from the experimental samples of inside extrudates stuffing, for 4 days are shown in Figure 1. The value of moisture that was extracted depends on the amount of free water which is absorbed by hull while in storage. Thus, the smaller amount of free water in the stuffing is the smaller value in the diagram and better are the results.

Based on the received data, we should select a group of stuffings (№ 4, 7, 8, 11, 12) in which the range of extracted moisture is only 4.5 - 5.6%.

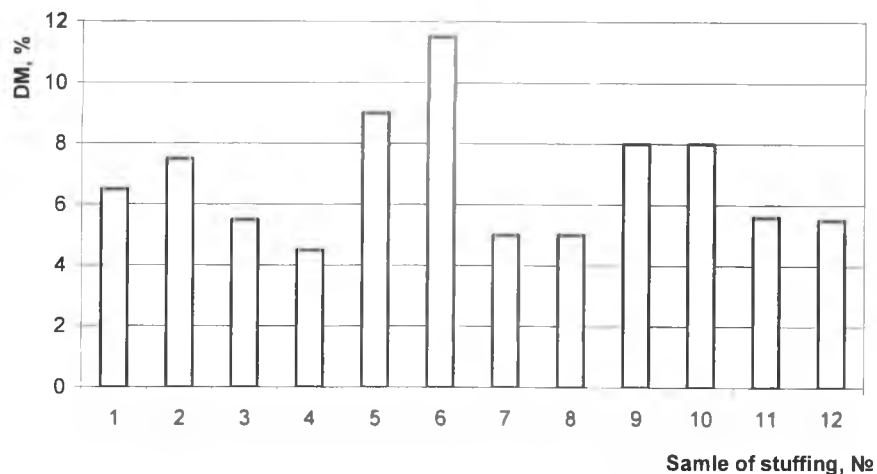


Fig. 1. The amount of moisture that extracted from the experimental samples of inside extrudate stuffings for 4 days.

Better results showed stuffing with pectin and modified starch Emjel (№4) and stuffings based on apple juice and pectin (№ 7, 8).

In other samples of stuffing the values are found in the range from 6,5 to 11,5% (№ 7, 3).

The total value of quality indicators is calculated as the area of the polygon pentagram). the results are presented by the diagram (Fig. 2).

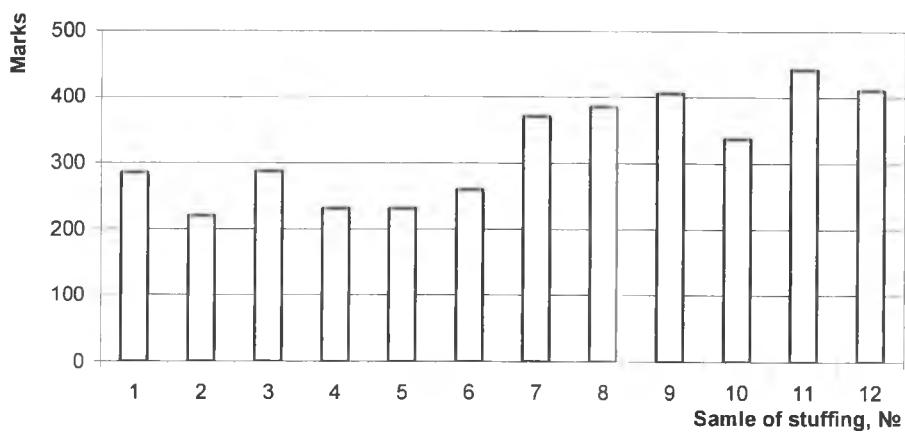


Fig. 2. Complex assessment of quality fruit stuffings quality based on the mixture of pectin and modified starch.

Conclusion

There have been identified and studied the causes of moisture migration (in co-extrusion products) from fruit stuffing into the hull. To create a stabilization system hydrocolloids and water-retaining agents - apple pectin and various types of modified starch have been selected.

The recipes of fruit stuffings containing stabilizing components in different proportions have been made. Experimental samples of fillings have been cooked according to the recipes and the impact of stabilization system on moisture-retaining ability has been analyzed.

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