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THE USE OF DOG-ROSE HIPS (*ROSA CANINA*) FRUITS IN THE PRODUCTION OF MARSHMALLOW-TYPE CANDY

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Abstract: *The marshmallow is a high-energy sugar-based product with a pleasant taste and aroma, chewable consistency, foamy structure with fine porosity, consumed by children. Artificial dyes are added during the manufacture of these candies to give them an appealing look. Studies show that the ingestion of tartrazine combined with a diet rich in trans fats, nitrites, nitrates and low fiber intake are linked to malignant tumors, especially in the esophagus, breast, rectum, stomach and ovaries. Hence, the substitution of the synthetic dye tartrazine with a natural food dye obtained from dog-rose (Rosa canina) fruits as a source of biologically active substances (tannins, polyphenolic compounds) is of particular interest. Marshmallow candy with the addition of dog-rose fruit i.e. 1.0% and 2.0% hydroalcoholic extract, and 1.0%, 2.0% and 2.5% dog-rose hip powder to the product mass were produced. The control sample was prepared in a similar way, by replacing the plant addition with 0.02% synthetic dye tartrazine. The physico-chemical and organoleptic indices of the samples corresponded to the acceptable values. It was found that the mass fraction of dry matter, the reducing substances and the acidity do not change significantly during storage. Following the determination of the (DPPH) antiradical activity of the candy by in vitro method, it was found that the percentage of DPPH inhibition in the control sample was negative, while in the samples with the addition of dog-rose fruit, the antiradical capacity had significant positive values.*

Keywords: *sugar-based products, vegetable matter, antiradical activity, quality.*

1. Introduction

The sugar-based products are characterized by high nutritional value, pleasant taste and aroma, attractive appearance, so that the demand for this product group is continuously increasing. According to FAO WHO CIFOCOss food consumption database, sugar-based products are highly demanded by different age groups, especially children [1]. On average 13100 tons of confectionery products were produced annually in the Republic of Moldova between 2007 and 2014, according to statistical data [2].

Marshmallow is a sugar-based product which is not traditional for the consumers of the Republic of Moldova. It is however similar to small-sized zephyr with a chewable consistency and a foamy structure with fine porosity. Initially, marshmallow was manufactured by using the common marh mallow (*Althaeae radix*) root, which when boiled produces a gluey and gelatinous mass, that can then be used to manufacture foamy products. Over time, the marshmallow root has been replaced with gelatin and starch [3]. Currently, marshmallow is becoming more and more popular, especially among children, due to

the variety of its forms, appearances and flavours. During the manufacture of these candies, artificial dyes are added to give them an appealing look. Studies show that ingestion of artificial dyes, such as tartrazine, combined with a diet rich in trans fats, nitrites, nitrates and low fibre intake is related to malignant tumours, especially in the oesophagus, breast, rectum, stomach and ovaries [4]. Other harmful observed effects are the allergic reactions, which can cause either simple allergies or even severe asthma and bronchitis [5]. Moreover, the literature shows that around 13% - 22% of people with aspirin allergies also have the same reactions after eating foods with tartrazine [6].

At present, a particular attention is paid to technologies based on natural sources of biologically active compounds, rich in antioxidants - substances with beneficial health effects [7-10].

The dog-rose (*Rosa canina*) hips are a part of the forest fruits, which are an important source of bioactive components (vitamin C, polyphenolic compounds, proantho-cyanidins, flavonoids, carotenoids, etc.) [11-14]. Rose hips are known to be efficacious in strengthening the body defence, especially against colds and for decreasing slightly the total cholesterol in humans [15-17]. The extract of hips significantly reduced the level of glucose in the blood, substantially inhibiting the weight gain and/or the accumulation of visceral fat, without affecting food intake in mice [18]. Thus, the substitution of the synthetic tartrazine with natural colourant made from dog-rose hips for the production of marshmallow candy, especially for children, is appropriate.The objective of this research was to develop the production technology of the marshmallow with the use of hydroalcoholic extract and powder of the dog-rose fruit in order to diversify the assortment of functional products. The studies were focused on the following directions: the analysis of the chemical composition of the hydroalcoholic extract; the determination of the quality indicators, the microbiological stability and the antiradical activity of candy.

2. Matherials and methods

The hydroalcoholic extract of the autochthonous dog-rose hips (*Rosa canina*) harvested in 2014 was used for this study. The hips were washed and dried at 65°C to a humidity of 8,0±0,25%. Then, the dried hips were ground to the powder and sieved. The granulation of the powder after sieving was 140µ. The obtained meal was subjected to hydroalcoholic extraction using 50% ethanol. The extraction was carried out in a solid-liquid ratio of 1:15 in the water bath under stirring. The obtained extract was filtered, distilled in a rotary evaporator at 65°C. An extract with a dry mass fraction 73,0±0,1% was obtained and stored in dark-coloured containers at 5,0±1,0°C.

The marshmallow-type candy were prepared using gelatin, sugar, molasses and water, with the addition of dog-rose fruit i.e. 1.0% and 2.0% hydroalcoholic extract and 1.0%, 2.0% and 2.5% rose hip powder of the mass of the product as a natural dye, but also as a source of biologically active compounds. The mixture of corn starch and powdered sugar was used to sprinkle candy. The control sample was prepared in a similar way, by replacing the plant addition with 0.02% tartrazine. The vacuum packed samples were stored in the refrigerator at 5±1°C.

The following analytical methods were used to determine the content of biologically active compounds in the dog-rose extract: the content of tannins by the Folin-Ciocalteu method [19], the phenolic compounds content by the Folin-Ciocalteu method [19] and antiradical activity by the DPPH method [20].

The physicochemical characteristics of the products were determined according to

[21]. The mass fraction of the dry substance by the refractometric method; the acidity; the mass fraction of reducing substances were analyzed. The sensory analysis of the products was carried out according to BS ISO 6658-2005 - Sensory Analysis - Methodology - General guidance [22] and the technical regulation "Confectionery food products" of the Republic of Moldova [23]. The microbiological analysis was carried out in accordance with the Rules on microbiological criteria for foodstuffs [24]. The total viable count was estimated.

The antiradical activity of the candy was measured using the spectrophotometric method with the free DPPH (2.2-diphenyl-1-picrylhydrazyl) radical [20]. The antiradical DPPH• activity of the products has been determined *in vitro* in order to simulate gastric digestion in the presence of pepsin (150 mg/100g of product), at pH=2,0±0,1 (1.5 M HCl), temperature 37.0±0.1ºC in water bath, under agitation at 60 min^{-1} for 2 hours [25]. The samples have previously been centrifuged at 6000 min^{-1} for 10 min, at 20±1ºC temperature, they have been filtered and tested as well [20]. According to bibliographical estimating, the correlation degree between *in vitro* scientific results, made by Monsen's model and the results obtained *in vivo* varie between 60 - 70% [26].

The variance analysis of the results was carried out by least square method with application of Student coefficient and Microsoft Office Excel program version 2007. The differences were considered statistically significant if probability was greater than 95% (*p*-value <0,05). All assays were performed in triplicate at room temperature 20 ± 1^0C. The experimental results are expressed as average±SD (standard deviation).

3. Results and discussion

Table 1 shows the content of tannins, phenolic compounds and the antiradical activity of the dog-rose fruit extract used in the manufacture of the candy [27]. The analysis of the results showed that the obtained extract is rich in biologically active compounds.

Table 1.
The content of tannins, phenolic compounds and the antiradical activity of rose fruit extract

Tannins, mg TAE/g d.w.	Total phenols, mg GAE/g d.w.	Antiradical activity,%
106.41±1.34	26.98±0.36	85.11±0.02

The mass fraction of dry matter and the acidity were determined on the 6th and 12th days from the production date to observe the changes during product storage. Table 2 presents quality physicochemical indicators of the marshmallows with 1,0% and 2,0% rose hip extract and with 1,0%, 2,0% and 2,5% rose hip powder to mass product as compared to the control sample with 0,02% tartrazine, during storage.

The results obtained in Table 2 showed that the dry mass fraction increased with the concentration of rose hip extract and powder compared to the control sample with synthetic dye, on the 6th day after production. Thus, the addition of 1% rose hip extract enhanced the mass fraction of dry substances by 0.41% and the addition of 2% - by 1.08%. The rose hip powder addition at the concentration of 1%, 2%, and 2.5% increased the dry mass fraction by 0.7%, 0.8% and 2.1%. respectively.

During the 12-day storage period, the dry mass fraction of the candy obtained increased insignificantly by an average of 1.2%. At the same time, it was observed that during the initial preservation period, the marshmallow samples absorbed the moisture and a layer of sugar-saturated solution was formed on the surface. Due to the diffusion of moisture from the upper

layers to the inner layers of the sample, the partial crystallization of the sugar occurred and the samples turned to the crystalline state [3]. This state was formed when the moisture balance of samples was reached. Thus, reducing the storage moisture content leads to increased content of dry matter, which demonstrates that the developed product is stable over time [21].

It was found that acidity augmented with increasing concentration of rose hip extract and powder and varied within the range of 1.3 – 2.5 degrees of acidity on the sixth day and within 1.4 – 2.6 degrees of acidity, after 12 days of storage. The rise in acidity can be explained by the chemical composition of the dog-rose fruit (L-ascorbic acid, fruit acids, organic acids, amino acids) [11].

Table 2.
The change of the quality physicochemical indicators of the marshmallow candy manufactured using rose hip extract, rose hip powder, and a synthetic dye during storage

Marshmallow -type candy	Quality indicators					
	The mass fraction of the dry matter, %		Acidity, Degrees		The mass fraction of reducing substances, %	
	After 6 days	After 12 days	After 6 days	After 12 days	After 6 days	After 12 days
Control sample	70.25±0.35	71.25±0.25	0.7±0.20	0.8±0.05	8.01±0.23	n.d.
With 1.0% extract	70.66±0.29	71.83±0.15	1.3±0.10	1.4±0.10	8.51±0.22	n.d.
With 2.0% extract	71.33±0.44	72.60±0.24	1.6±0.20	1.7±0.20	8.68±0.18	n.d.
With 1.0% powder	70.95±0.12	71.75±0.15	1.1±0.10	1.2±0.05	8.21±0.26	n.d.
With 2.0% powder	71.05±0.30	72.50±0.10	2.1±0.10	2.2±0.10	8.36±0.32	n.d.
With 2.5% powder	72.35±0.15	73.80±0.16	2.5±0.05	2.6±0.10	8.53±0.31	n.d.

n.d. – not determined

At the same time, the mass fraction of the reducing substances augmented insignificantly with the increase of the plant matter concentration. In the case of the extract, this indicator varied between 8.51 – 8.68%, while in the case of rose hip powder - between 8.21 – 8.36%, but it did not exceed the maximum value of 10% [23].

The analysis of the obtained results showed that the physicochemical parameters of the candy corresponded to the regulated admissible values according to the Government Decision no. 204 [23] after 6 days and 12 days from the production date.

The organoleptic analysis of the marshmallow was also carried out in order to place the product on the market. The organoleptic evaluation of the candy was carried out using the 5 point system. Obviously, the smell and taste of fortified candies with extracts and powder from rose hips differed from candy with synthetic dye, Fig. 1.

The appearance of the candy containing rose hip powder varied from the control sample by the presence of fruit particles in their structure, which did not influence

essentially this index. At the same time, the powder of rose hips contained soluble and insoluble fibres that influenced the structure and consistency of marshmallow candy. Fortified candies with 2% powder had a more elastic consistency than the control sample, but with increasing admixture, other organoleptic markers such as appearance and taste worsened. The best results have been obtained for marshmallow fortified with 2% fruit powder to the weight of the product.

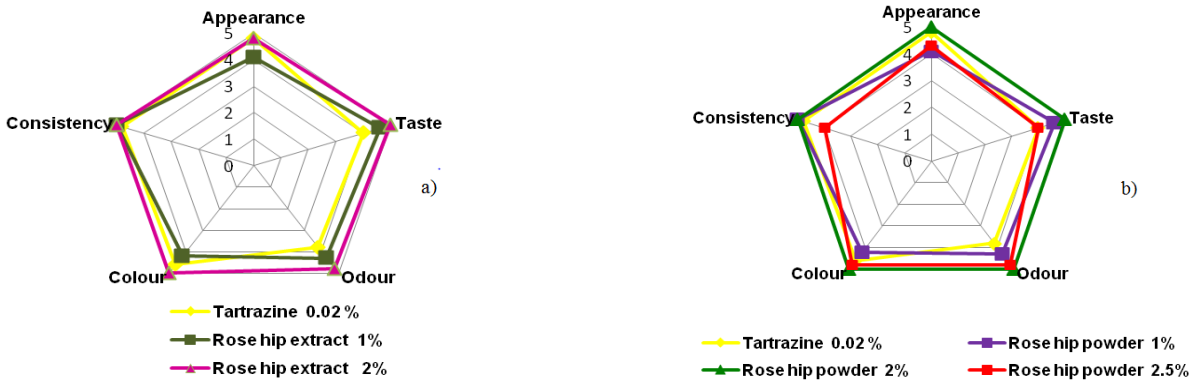

Fig.1. Profiles of marshmallow candy with: a) rose hip extract; b) rose hip powder compared to the control sample with tartrazine.

The influence of the rose hip extract and powder on the microbiological stability of candy against the synthetic dye was also investigated. Table 3 shows the evolution of total viable count (TVC)* during the storage of marshmallows obtained with the addition of rose hip extract, rose hip powder and synthetic dye tartrazine. The study has shown that the total viable count decreased with increasing concentration of the plant matter, which confirms its antimicrobial activity [28].

Table 3.
The evolution of the total viable count (TVC)* during the storage of marshmallows containing rose hip extract and rose hip powder

Parameter Marshmallow-type candy	TVC (total viable count), % of the maximum admissible number	
	After 6 days	After 12 days
Control sample	6.81	21.32
With 1.0% extract	5.27	16.81
With 2.0% extract	4.65	16.32
With 1.0% powder	2.27	15.45
With 2.0% powder	2.29	13.74
With 2.5% powder	1.81	13.07

* nutrient agar

All tested products had the total viable count corresponding to the acceptable value, after 6 and 12 days of storage [24]. The presence of biologically active compounds essentially influences the stability and the antioxidant ability of food products [29].

The antiradical activity (% inhibited DPPH free radicals) of the candy containing rose hip extract and rose hip powder in the conditions of the stomach digestion was investigated in this study. It was found that the control sample containing tartrazine had DPPH-negative antiradical activity i.e. (-29.33±1.21%), exhibiting an oxidizing action. In the samples with the optimal concentration of dog-rose fruit extract and powder, the antiradical activity was positive (12.35±0.56% and 21.29±1.11% respectively), which presents an extremely important argument in favour of these products.

4. Conclusion

The analysis of the organoleptic indices, physicochemical indicators, the

microbiological stability and the antiradical activity of marshmallow has shown that this product is competitive as it exhibits functional properties due to the presence of the biologically active compounds of the dog-rose hips, and can thus be recommended for consumption.

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