

CHARACTERIZATION OF FRUIT YOGHURT WITH APPLE CUBES OSMODEHYDRATED IN MOLASSES

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Abstract

In this investigation fruit yoghurts were produced by adding apple cubes, osmotically dehydrated in sugar beet molasses, in different quantities. The aim was to investigate effects of added fruit on nutritional and sensorial properties of obtained products.

Osmotic dehydration process involves immersion of food materials in hypertonic solutions. This treatment has important advantages compared to the other drying methods: low temperature and energy requirements, low waste material and good quality of final product. During osmotic treatment, apple cubes are not exposed to high temperatures, minimizing, in that way, sensory characteristics changes, and preserving nutritional values of the fresh apple: vitamins, minerals, etc. Osmotic dehydration of apple was conducted in concentrated sugar beet molasses (80%w/w), during 5 hours under constant conditions (20 °C and atmospheric pressure). Fundamental chemical composition was determined by SRPS ISO methods, and mineral content was determined using Atomic absorption spectroscopy - AAS.

High content of solids in molasses provides high osmotic pressure and allows great loss of water from immersed apple cubes during this process. On the other hand, chemical analysis showed that sugar beet molasses, due to its complex composition, improved nutritional value of dehydrated apple, which is primarily related to the increase of mineral content. Content of sucrose in dehydrated apple (compared to fresh apple samples) was increased from 5.14±0.02 (g/100g) to 12.22±0.14 (g/100g). Content of K, Na and Mg was increased about three times, and content of Ca about two times, in comparison to the fresh apple.

Therefore, the addition of apple dehydrated in molasses, directly affects the improvement of the nutritional profile of fruit yoghurt. Sensory analysis revealed satisfactory results, for all investigated fruit yoghurts.

Key words: Fruit yoghurt, Apple cubes, Osmotic dehydration, Sugar beet molasses.

1. Introduction

Presently, the food industry has tendency to cover the growing consumer demand for new functional products enriched in some nutritional valuable ingredients. At the same time, tends to achieve maximum economic feasibility of the production with minimum energy consumption and maximum reduction of the process waste [1]. Yoghurt is in an advantage compared to milk from which it is prepared, due to its nutritive, digestibility and therapeutic properties [2]. The addition of fruit (fresh or dried) in yoghurt, even more improves its nutritive characteristics, and favours the consumers' perception, due to its specific sensorial properties, above all taste and sweetness [2, and 3]. Numerous fruit yoghurts (banana, strawberry etc.) have been prepared, but apple stirred yoghurt has more distinct nutritive and medical benefits than other fruit yoghurts. Apple is a rich source of vitamins and minerals, primarily potassium and iron [2].

Osmotic dehydration (OD) is the method appropriated for extending fruits sustainability, and a common process for producing dried fruits, which can be used as an ingredient in yoghurts [4]. During OD, fruit is not exposed to high temperatures, minimizing, in that way, sensory characteristics changes, such as colour, aroma, flavour and texture, and preserving nutritional valuable compounds [5]. Traditional preservation methods like drying, canning and freezing result in final products that are low in quality compared to their original fresh state [6]. Unlike these methods, OD has noticeable advantages providing shelf-stable and high quality processed products. Furthermore is environmentally

acceptable and energy efficient process, because of low temperature and energy requirements and low waste material [7]. OD is performed by immersing fruit in suitable hypertonic solution. Driving force for water removal is the difference in osmotic pressure between the surrounding solution and submerged fruit [8]. The complex cellular structure of plant tissue, act as a semi-permeable membrane, which allows two main count current flows: water from the plant tissue flows into the osmotic solution whereas osmotic solute diffuses from the solution to the tissue [9].

Previous research of Lević *et al.*, [10] has shown good behaviour of sugar beet molasses as hypertonic solution for OD. Sugar beet molasses is accessible and cheap raw material, and could be used as a replacement for sucrose [11]. Also, sugar beet molasses can be used in the OD process without previous preparation and therefore leads to process time and energy saving. High content of solids (around 80%) provide high osmotic pressure in the solution and allows greater loss of water during OD and enhances the efficiency of this process. On the other hand, specific chemical composition of molasses (approximately 51% sucrose, 1% raffinose, 0.25% glucose and fructose, 5% proteins, 6% betaine, 1.5% nucleosides, purine and pyrimidine bases, organic acids and bases) enriches chemical and nutritional composition of dehydrated products [12, and 13].

In this investigation fruit yoghurts were produced by adding apple cubes, osmotically dehydrated in sugar beet molasses, in different quantities. The aim was to investigate effects of added fruit on nutritional and sensorial properties of obtained products.

2. Materials and Methods

Apples for the experiment were purchased on the local market. Prior to the treatment, the apples were stored at 4°C and then thoroughly washed and cut into cubes, dimension 1x1x1 cm. After measuring the initial mass, samples of apple were dipped into concentrated sugar beet molasses (80% dry matter). The material to molasses ratio was 1:5, and immersion lasted 5 hours, under constant conditions (temperature of 20 °C and room atmospheric pressure). After process of OD apple samples was taken out from molasses, lightly washed with water and gently blotted with paper towels to remove excessive water from the surface. The dehydrated apple cubes were weighed and after that, dry matter content, content of sucrose and content of some minerals (K, Ca, Na and Mg) were determined. The samples were kept in an oven (Instrumentaria Sutjeska, Croatia) at 105 °C until constant weight was attained and dry matter content calculated from the samples weights before and after drying. The content of mineral matter was determined by atomic absorption spectrophotometer AAS 30-Carl Zeis. The sugar composition was

determined by Luff-Schoorl-u [14]. All analytical measurements were carried out in accordance to AOAC methods [15]. Water activity (a_w) of the fresh and dehydrated apple cubes were measured using a water activity measurement device (TESTO 650, Germany) with an accuracy of ± 0.001 at 20 °C.

In order to define mass transfer kinetics of OD, the values of water content were followed as well as the changes in weight and in the content of dry matter (DMC). Using these, important kinetics parameters, water loss (WL) and solid gain (SG) were calculated, as described by Koprivica *et al.*, [8].

The apple cubes dehydrated in sugar beet molasses were added in commercial yoghurt in quantities of 2, 5, 10 and 15%. Sensory evaluation of these four samples of fruit yoghurt was carried out according to Nelson and Trout [16].

3. Results and Discussion

In Table 1 are presented some data which describe the influence of OD on apple. After process of OD, initial dry matter content in the apple samples increased from initial 13.724 to 37.726%. The SG shows the degree of penetration of solids from molasses to the apple sample. This solid uptake is desirable, because molasses has complex chemical composition conducive to impregnation of nutritional valuable compounds, sugar components and minerals in dehydrated apple. The high value of WL indicates that there was a noticeable loss of water from apple cubes during dehydration process. Also, it was shown that OD has positive influence on the reducing a_w value of the apple dehydrated in molasses which should lead to the reduction of microbial load. Fresh sample of apple in initial state had a_w of 0.938 which is close to the optimum growth level of most microorganisms [17]. After OD, a_w value in treated apple was 0.891, which is lower than a_w values that inhibit bacterial growth.

Table 1. Changes of dry matter content and water activity and the kinetics parameters during osmotic dehydration of apple in sugar beet molasses

DMC, %	WL, g/g initial sample weight	SG, g/g initial sample weight	a_w
37.726	0.598	0.022	0.891

Minerals have irreplaceable significance for normal functioning of every organism and their role in maintaining health is very important [8]. It is known that sugar beet molasses represents a significant source of many minerals, especially K, Ca, Fe and Mg. Particularly significant is the fact that all the mineral components in the molasses are in dissolved state and the K is in much greater quantities than all other cations about

4g K/100g molasses [14]. For this reason, using molasses as osmotic agent during OD of apple improves mineral composition of final products. By analysing the content of mineral components (K, Na, Mg, Fe and Ca) in the apple osmotically dehydrated in molasses increase the amount of all these mineral substances was observed (Table 2).

Table 2. Effect of osmotic dehydration to increase mineral and sugar content in apple

Mineral and sugar content	Fresh apple	Dehydrated apple
K (mg/100 g)	280.00 ± 1.05	824.88 ± 1.28
Ca (mg/100 g)	38.10 ± 0.26	80.83 ± 1.14
Na (mg/100 g)	24.30 ± 0.50	77.15 ± 0.62
Mg (mg/100 g)	11.40 ± 0.05	30.18 ± 0.23
Sucrose (g/100 g)	5.58 ± 0.05	13.20 ± 0.05
Invert sugar (g/100 g)	5.14 ± 0.02	12.22 ± 0.14

The most pronounced increase was observed in respect of K, from initial 280 mg to final 824.88 mg. It was also obvious increasing of content of Na and MG, about 3 times in comparison to the fresh apple. The content of Ca was about two times greater, as compared to the apple in fresh state. Sugar beet molasses contains over 50% of sucrose, hence content of sucrose in dehydrated apple (compared to fresh apple samples) was increased from 5.58 ± 0.02 (g/100g) to 13.20 ± 0.14 (g/100g). Also increases the amount of invert sugar in dehydrated apple. Apple enriched with non-refined sugar from molasses is a good addition to fruit yoghurts, because it reduces the need for additional sweetening.

Therefore, the addition of apple dehydrated in molasses, directly affects the improvement of the nutritional profile of fruit yoghurt.

The addition of dehydrated apple cubes resulted in a change in flavour, texture, sensory acidity and appearance. Sensory analysis was conducted in order to monitor changes in these sensory properties depending on the amount of added apple cubes. For determining general sensory profile the intensity of each property was rated for all four samples of apple stirred yoghurt (Table 3). The aim was to investigate and determine what amount of added apples is the most appropriate in terms of sensory acceptability and quality of final product.

The data from Table 3 show that the addition of 2% apple cubes in yoghurt was assessed with the lowest rates. Consequently it can be regarded as inadequate, primarily because of the very pronounced sensory acidity. Increasing addition of apples to 5% was influenced on the improvement of all investigated sensory properties. But, it was rated that the addition of 10%

of apple cubes was the best proportion for the preparation of yoghurt. Yoghurt with 10% has the most convenient taste, texture and appearance, in comparison to the other tested yoghurts. Generally, yoghurt prepared by using 10 and 15% was estimated with a higher sensory scores compared to the yoghurt prepared by using 2 and 5% apple cubes. The addition of apple cubes dehydrated in molasses contributed to increased sweetness, and accordingly to decreased acidity of yoghurt. Therefore, the lowest estimated sensory acidity has yoghurt with 15% apple cubes. After stirring the apple cubes with yoghurt, alternation in colour was observed. This coloration derives from molasses in which apple cubes was dehydrated. If there were a higher percentage of added apple cubes in yoghurt, more pronounced brownish colour of obtained yoghurt was obvious.

Table 3. Sensory evaluation of fruit yoghurt with 2, 5, 10 and 15% apple cubes dehydrated in sugar beet molasses added

Addition of apple cubes (%)	Flavour (45)	Texture (30)	Sensory acidity (10)	Appearance (15)
2	18	15	7	8
5	26	28	5	10
10	40	24	3	14
15	34	21	2	12

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4. Conclusions

- Apple cubes osmodehydrated in sugar beet molasses are convenient addition to fruit yoghurt, both for the nutritional and sensory aspects and in terms of en-chased sustainability.
- Sugar beet molasses, due to its complex composition, increases mineral and sugar content in dehydrated apple, which improve nutritional value and sweetness of yoghurt.
- The addition of 10% of apple dehydrated in molasses to yoghurt has proved to be the best option in terms of sensorial properties.

5. References

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