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Achievement of a Fortifying Product based on Apples, Quinces and Sea Buckthorn

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Abstract

The aim of the research was to achieve a fortifying product "Apple, Quince and Sea Buckthorn Nectar" rich in antioxidants (vitamin C, β-carotene) and dietary fibers (cellulose, pectic substances) from fruit. In the experiments were used fruit (apples, quinces and sea buckthorn) with a high content of these nutrients. The antioxidants are chemical substances that inhibit, decompose or prevent forming of free radicals or other substances that induce the cancerogenesis. Also, dietary fibers are another group of natural compounds with important role in prevention of the digestive diseases. In the experiments were used biochemical methods for analysis of fruit and processed products (determination of soluble dry substance, glucides, proteins, lipids, mineral elements, total acidity, vitamin C, β-carotene, cellulose, pectic substances etc.). Also were performed microbiological analysis and sensorial analysis for processed products.In order to obtain the product "Apple, Quince and Sea Buckthorn Nectar", four variants of experiments were carried out at the laboratory level. Following the sensorial and biochemical analyses, the optimum variant of the product "Apple, Quince and Sea Buckthorn Nectar" was selected, namely the variant V3 in which the ratio apple puree and quince puree was 1:1 and the percentage of added sea buckthorn juice was of 3%.

Keywords: fortifying nectar, apple, quince, sea buckthorn, antioxidants, dietary fibers

Introduction

The healthy nourishment of the population is a major problem debated both by the European Union and by other developed countries of the world (Knorr, 1998). Balanced nourishment is a part of essential means of prevention of the society's serious illnesses. Thus, scientifically modulating the food content in macro- and micronutrients, the nourishment can become a potential factor of stoppage, reconversion and normalization of different stages of the nutrition diseases evolution (Segal, 2005).

In the USA, the Institute of Medicine's Food and Nutrition Board defines the functional food as "any food or food component that can supply benefits for health, besides its content of traditional nutrients" (Bloch, 1996).

The food for health named also - Food for Specific Health Uses (FOFHU) - are foodstuff containing biologically active products, obtained from raw material with high biologic potential or by processing which allows such a potential and which, consumed with current food, contribute to maintain the optimum state of physical and mental health of the population (Hasler, 1998).

Such foodstuff can be a natural product, obtained from raw material containing useful components from the biological point of view. No doubt, the most reach sources of compounds with beneficial effects for health are vegetal products (Velnet, 1993).

The assortment is very big and we can say that for almost each type of such products there are substances that positively influence the physiological processes of the organism (Velnet, 1993).

The functional foods obtained from fruit are ideal for satisfying the nutritional needs of the population and prevention of several illnesses, as for example cancer, cardiovascular diseases, self-immune illnesses, as well as nutritional anemia, because this products contents antioxidants and dietary fibers (Liu, 2003).

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The aim of the research was to achieve a fortifying product "Apple, Quince and Sea Buckthorn Nectar" rich in antioxidants and dietary fibers from fruit to meet the quality of a functional food.

Materials and methods

The experiments were carried out in 2003-2004 at the Research-Development Institute for Processing and Marketing of Horticultural Products – HORTING Bucharest within the frame of the Laboratory of Research – Processing of Horticultural Products.

In the experiments, the following raw materials and auxiliary materials were used: fruit (apples - cultivar "Romus 5", quinces - cultivar "Aurii", sea buckthorn – cultivar "Serpeni"), sugar, bottles (250 ml) and caps.

The raw material used in the experiments was provided by Research and Development Horticultural Station Gorj - Tg. Jiu Romania (quinces) and Research Institute for Fruit Growing Pitesti – Maracineni Romania (apples and sea buckthorn).

In order to obtain the fortifying product "Apple, Quince and Sea Buckthorn Nectar" the following stages were crossed: characterization from the sensorial and biochemical point of view of the raw materials: apples, quinces and sea buckthorn; set up of the flow sheet and of the experimental variants in lab conditions; sensorial, biochemical and microbiological analyses of experimental variants; definitization of recipe and processing technology for optimum variant; elaboration of the Standard and Technological Instruction; product certification.

In laboratory, many experimental variants were carried out in order to obtain the product "Apple, Quince and Sea Buckthorn Nectar" with the ratio of the apple puree, quince puree and added sea buckthorn juice percentage as a variable factor:

V1 – apple puree: quince puree = 1:3, sea buckthorn juice 2.5%;

V2 – apple puree: quince puree = 3:1, sea buckthorn juice 2%;

V3 – apple puree: quince puree = 1:1, sea buckthorn juice 3%;

V4 – apple puree: quince puree = 2.5:1.5, sea buckthorn juice 2%;

The ratios and percentage used in experimental variants were set according to the biochemical composition of the raw materials.

To obtain fluid products and to harmonize the sensorial qualities, the fruit puree was diluted in the vessels of mixing with sugar syrup. The ratio of mixing fruit puree: sugar syrup has been 40:60 according with processing technology for nectar (Gherghi, 1999).

To improve the sensorial and nutritional quality of the nectar, the sea buckthorn juice was added in proportion of 2-3%. A higher percentage of the sea buckthorn juice added may affect the sensorial quality of the final product.

Biochemical analyses of the fresh fruit and processed products were determined according to official Romanian standards methods (Colectia de Standarde pentru Industria Conservelor de legume şi fructe, 1990).

The antioxidants (vitamin C, β-carotene) and the dietary fibers (cellulose, pectic substances) were determined by biochemical analysis in both the raw material and the processed products.

Determination of vitamin C was done by extraction of ascorbic acid using a solution of 2% oxalic acid and then titrating with 2.6 -diclorfenolindofenol stain in excess. The excess stain was extracted using chloroform and was determined by spectrophotometer at the wave length of 520 nm (STAS 5950-85).

β-carotene was extracted with hexane and separated from other substances by crossing column chromatography filled with aluminum oxide. The yellow colour of solution was measured at a spectrophotometer at a wave length of 450 nm.

Cellulose was determined by the method Kurskhner-Hanck. The method was based on solubility of all components of the sample in a mixture of acids (acetic, nitric, trichloracetic) except cellulose. Cellulose was separated by filtration and then was determined gravimetric.

Determination of pectic substances was done by gravimetric method. Pectic substances were precipitated with absolute alcohol hydrolyzate with sodium hydroxide 10% converted into pectic acid by acidification with hydrochloric acid and determined gravimetric. Pectice substances content was expressed in pectic acid.

Water from fruit was determined by weighing the sample after it was inserted in the thermostat at a temperature of 105°C.

Determination of soluble dry substance was achieved with a Tab. refractometer Abbe type, method of analysis STAS 5956-71.

Determination of glucides was done by the method Bertrand. The proteins were determined by the method Kjeldhal (STAS 8613/6-80). The lipids were determined by the method Soxhlet (STAS 5957-71). Mineral elements were determined with a Flame Photometer.

Determination of total acidity was achieved by titrating the sample with solution of sodium hydroxide in the presence of phenolphthalein as indicator (STAS 5951-79; SR EN 12147-99).

Determination of heavy metals (Pb, Cu, Cd) of the samples was done by dry mineralization using an atomic absorption spectrophotometer.

Determination of nitrite was done by measuring the intensity of color at spectrophotometer of azoic compound formed after reaction of diazotize of sulfanilic acid and nitrite aqueous extract of the sample and coupling with α-naphthylamine (STAS 11581-83).

Sensorial analyses of the processed products were achieved by "The method of comparison with stairs uniform score of 0-5 points" (STAS 12656-8) to evaluate each sensorial characteristic (aspect, color, flavor, taste). Nine specialists were analyzed sensorial characteristic of the experimental variants. In every tasting sheet of the experimental variants specialists have noted the aspect,

color, flavor, taste with notes of 0 - 5 set standards for sensory analysis (5 – "very good", 4 – "good", 3 – "satisfactory", 2 – "unsatisfactory", 1 – "inadequately", 0 – "altered"). By summing the medium scores resulting total medium scores of processed products (18.1 - 20 – "very good"; 15.1 - 18 – "good"; 11.1 – 15 – "satisfactory"; 7.1 - 11 – "unsatisfactory"; 0 - 7 –" inadequately").

Minimum medium score for the total product may be delivered is 10.1, 11.1 and 12.1 points (satisfactory) depending on the product and is determined by sensory analysis of standard product and medium score for each organoleptic characteristic must be at least 2.8 points (Colectia de Standarde pentru Industria Conservelor de legume şi fructe, 1990).

Microbiological analyses of the processed products were determined through inoculation of samples from experimental variants on selective media immediately after preparation, incubated in a thermostat (35°C for bacteria and 24°C for yeasts and moulds) and examined at microscope. The selective media used in experiments were: glucose broth with tomato juice for bacteria and malt agar for yeasts and moulds(Colectia de Standarde pentru Industria Conservelor de legume şi fructe, 1990). The devices used in microbiological analysis were: thermostat, microscope, laminar flow hoods, Petri dishes, pipettes, tubs and specific media.

The technological flow sheet for the product "Apple, Quince and Sea Buckthorn Nectar" included the following stages: qualitative and quantitative checking, sorting I, washing, sorting II, cleaning, cutting, preliminary heat treatment at 95°C for 5-10 minutes, crushing - refining, mixing with sugar syrup, homogenization under pressure at 150-180 A, de-aeration under vacuum at about 40°C, filling bottles, hermetic sealing, pasteurization at 100°C for 20 minutes, cooling at 40°C, labeling and storage (Gherghi, 1999).

Results and discussion

The aim of the experiments was to achieve a new fortifying product, natural, rich in antioxidants and dietary fibers based on apples, quinces and sea buckthorn.

The biochemical composition of apple, quince and sea buckthorn is presented in Tab. 1.

The results of the biochemical analyses for the used raw material shows that the sea buckthorn has a high content of vitamin C (175.25 mg/100g) and β-carotene (6.25 mg/100g), and the apples and quinces have a high content of glucides.

It was analyzed the pollutants content (heavy metals, nitrites, nitrates) of the apples, quinces and sea buckthorn, which is in the limits allowed by the Order of the Ministry of Health No. 975/1998.

The product "Apple, Quince and Sea Buckthorn Nectar" processed in the four variants was subject to sensorial and qualitative biochemical analyses in order to choose the optimum variant. The results of the analyses are presented in tables 2 and 3.

The variants V1, V3, V4 have had total medium score between 19 - 20 points. These variants have been appreciated by the group of specialists who gave high scores for all four sensorial characteristics: aspect, taste, colour, flavour. The variant V2 has had total medium score 17.5 points. The variant V2 has had lower scores for all four sensorial characteristics: aspect, taste, colour, flavour.

Tab. 1.Biochemical composition of raw materials

Biochemical indicators	Apple	Quince	Sea Buckthorn
Water (%)	86.50	85.2	83
Glucides (%)	8.25	6.75	2.35
Proteins (%)	0.30	0.40	1.57
Lipids (%)	0.25	0.51	7.25
Minerals (%)	0.40	0.45	0.40
Ca (mg/100g)	7.25	12.35	98.25
Mg (mg/100g)	3.80	5.45	12.50
K (mg/100g)	135.20	200.35	140.85
Na (mg/100g)	2.20	3.10	26.50
P (mg/100g)	8.50	20	7.35
Fe (mg/100g)	0.45	0.60	0.04
Vitamin C (mg/100g)	14.25	16.25	175.25
β-carotene (mg/100g)	0.32	0.35	6.25
Total acidity (g malic acid/100g)	0.40	1.12	2.95
Cellulose (%)	0.69	1.49	3.05
Pectic substances (%)	0.80	0.95	0.51
Energetic value (kcal/100g)	36.45	33.19	80.93

Tab. 2. Quality indicators of experimental variants

Quality indicator	V1	V2	V3	V4
Sensorial properties Product aspect	Turbid liquid, homogenous with superficial sediment			
Consistency	semi-fluid			
Colour	yellowish	white- yellowish	yellow-orange	yellowish
Taste and smell	sweet with quince flavour	sweet with apple flavour	sweet-soury with apple, quince and sea buckthorn flavour	sweet with quince flavour
Flavour	intense	intense	intense	intense
Biochemical properties Soluble dry substance (%)	13.2	13.5	13.4	13.5
Glucides (%)	11.3	11.59	11.50	11.56
Proteins (%)	0.3	0.35	0.3	0.33
Lipids (%)	0.4	0.45	0.49	0.44
Total acidity (g malic acid/100g)	0.85	0.82	0.8	0.83
Minerals (%)	0.32	0.28	0.27	0.26
Ca (mg/100g)	5.22	4.9	4.92	4.96
Mg (mg/100g)	2.95	2.65	2.75	2.6
K (mg/100g)	76.35	75.24	73.25	73.64
Na (mg/100g)	1.65	1.25	1.15	1.16
P (mg/100g)	6.03	5.94	5.92	5.9
Fe (mg/100g)	0.25	0.24	0.23	0.22
Vitamin C (mg/100g)	14.26	14.25	14.35	14.20
β-carotene (mg/100g)	2.3	2.25	2.36	2.25
Cellulose (%)	0.31	0.22	0.26	0.24
Pectic substances (%)	0.22	0.20	0.21	0.20
Energetic value (kcal/100g)	50	51.81	51.61	51.52

The variant V2 has had the highest content of glucides, lipids and proteins, which was observed also by calculation of the energetic value (51.81 kcal/100g).

The variant V1 has had the highest content of total acidity (0.85 g acid malic/100g) and in mineral substances (0.32 g/100g) and variant V3 has had the highest content of vitamin C (14.35 mg/100g) and β-carotene (2.36 mg/100g).

All the four experimental variants were microbiologically analyzed registering the absence of aerobe and anaerobic, mesophile and thermophile bacteria, as well as the absence of yeasts and moulds.

Following the sensorial and biochemical analyses, the optimum variant of the product "Apple, Quince and Sea Buckthorn Nectar" was selected, namely the variant V3 in which the ratio apple puree and quince puree was 1:1, and the percentage of added sea buckthorn juice was of 3%.

Based on the optimum variant the test lot was achieved and the Standard and the Technological Instructions were elaborated for the product "Apple, Quince and Sea Buckthorn Nectar". The recipe to obtain 100 kg of product "Apple, Quince and Sea Buckthorn Nectar" with soluble dry substance of minimum 13oR is presented in Tab. 4.

Conclusions

The fortifying product "Apple, Quince and Sea Buckthorn Nectar" has the qualities of a functional food, being a natural product, rich in antioxidants (vitamin C, β-carotene) and dietary fibers (cellulose, pectic substances).

The fortifying product is characterized by special nutritional and sensorial qualities and observes the requirements from the Order of the Health Ministry No. 975/1998 regarding the Hygiene-sanitary norms of foods.

"Apple, Quince and Sea Buckthorn Nectar" was certified by the Inspection Certificate No. -11248/10.05.2004 issued by ICA-CALITAL.

Tab. 3Sensorial analyses of experimental variants

Experimental variants	Aspect (score)	Colour (score)	Taste (score)	Flavour (score)	Total medium score (Pmt)	Qualificative
V1	4	5.592	5.592	3.904	19	very good
V2	3.816	5.064	5.196	3.464	17.5	good
V3	4	6	6	4	20	very good
V4	3.904	5.856	5.724	3.816	19.3	very good

Tab. 4 Recipe for 100 kg product "Apple, Quince and Sea Buckthorn Nectar"

Components	Soluble dry substance (%)	Quantity (kg)
Apple puree	6.5	18.5
Quince puree	6.5	18.5
Sugar syrup	17.18	60
Sea buckthorn juice	9.5	3

The development of the functional foods represents a unique opportunity to contribute to the improvement of food qualities and of the consumers' health state.

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