PRELIMINARY RESEARCH ON THE CONTENT OF MACRONUTRIENTS IN VEGETAL INGREDIENTS USED TO OBTAIN REFORMULATED MEAT PRODUCTS

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Abstract

The scientific research have demonstrated the reformulation posibility of meat products by adding some vegetal ingredients. The technological strategies which were applied have followed the percentage raising of the valuable nutritive components. The aim of the present study it was the identification of macronutrients (protein, carbohydrates, lipids, mineral substances) and micronutrients (ascorbic acid, β-carotene and total polyphenols) from vegetal sources (walnuts, mushrooms, sea buckthorn berries and rose hip). The determination of macronutrients content was attained by standard methods and for the ascorbic acid, β-carotene and total polyphenols there have been used spectophotometric methods. It was revealed the ascorbic acid content for sea buckthorn berries (253 mg %) and the total polyphenols contained by the rose hip (143.17 mg %). The lipid profile of walnuts, the mushrooms' β-glucans and also the antioxidant capacity of sea buckthorn berries and rose hip can be used for the meat products nutritional optimization. The nutritional profile modification for the 4 types of meat products with vegetal admixture, having a functional role, has been evaluated by statistic methods.

Key words: Meat, walnuts, mushrooms, sea buckthorn, rose hip

INTRODUCTION

Since meat contains an abundance of proteins with high biological value, meat is categorized with fish and eggs as a protein food group in dietary food guides [15]. In other words, in terms of nutrition, meat is an excellent diet source of essential amino acids. Meat also plays an important role in supplying our diet with minerals and vitamins, such as iron, zinc, selenium, and B vitamins [18], [8]. As well as these basic nutritional components, studies have revealed that meat contains several bioactive compounds, such as conjugated linoleic acid, carnosine, and L-carnitine [4]. However, consumers often associate meat and meat products with a negative health image. This regrettable image of meat is mainly due to its content of fat, saturated fatty acids, and cholesterol, and their association with chronic diseases, such as cardiovascular diseases, some types of cancer, and obesity [9]. [21], [22], [12], [24]. Also, intake of sodium chloride from meat products has been linked to hypertension [23].

In addition to accumulation of scientific evidence, there is a need to inform consumers of the exact nutritional value of meat and meat products. The most important factor for evaluation of foods is their "*primary*" function (i.e., their role in providing standard nutrient components). The "*secondary*" function of food, which is defined in terms of sensory properties such as taste, flavor, appearance, and texture, is also important for consumers and the food industry. In addition to these basic functions of foods, the "*tertiary*" function of foods has attracted considerable attention due to increasing concerns about health in developed countries. Tertiary functions are the roles of food components in preventing diseases by modulating physiological systems.

Examples of tertiary functional properties are antioxidative, antiaging activities, anticarcinogenic, antihypertensive and

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The manuscript was received: 14.03.2013
Accepted for publication: 18.09.2013

immunomodulating. Foods utilizing or emphasizing such tertiary functions are regarded as "*functional foods*". Although there has been extensive research and development of functional foods in the dairy industry [10], [11], little attention has been paid to functional meat products until recently. However, efforts have been directed in recent years to research of functional meat products [13], [5], [6], [7], [12], [4]. Since meat products are important in the diet, the development of novel healthier meat products will contribute to human health. The objective of this study was to investigate the effect of reformulated meat-based functional foods on human body in which bioactive compounds are added in appropriate amounts to achieve a functional effect. The aim of the present study was the identification of macronutrients and micronutrients from vegetal sources (walnuts, mushrooms, sea buckthorn berries and rose hip) and to estimate the amount of total polyphenols, ascorbic acid and β–carotene in some meat reformulated products.

MATERIAL AND METHOD

Materials

The mushrooms (*Agaricus bisporus L.*) and nuts (*Juglans regia L.*) were purchased from a local market. Sea buckthorn berries (*Hippophaë rhamnoides L.*) and rose hip (*Rosa canina L.*) were provided by S.C. Hofigal Export Import S.A., Bucharest.

Methods

Macronutrients content of mushrooms and nuts were determined using [3].

For determination of bioactive compounds of sea buckthorn berries and rose hip were performed following analyzes: determination of ascorbic acid content, carotenoids and total phenolics. All the samples were analyzed for chemical composition (moisture, protein, fat, carbohydrates and ash) using the [3] procedures**.**

Determination of ascorbic acid. Ascorbic acid was determined according to the method of [14].

Determination of β–carotene. β–carotene was determined according to the method of [19]. Content of β–carotene was calculated according to the following equations:

$$\beta - \text{carotene (mg/100 mL)} = 0.216 \times A_{663} - 1.220 \times A_{645} - 0.304 \times A_{505} + 0.452 \times A_{453}$$

Determination of total phenolics. Total phenolics were estimated based on procedures described by [25] with some modifications.

All physico-chemical analyses were carried out in triplicate.

To estimate the daily dose ingested by eating meat reformulated products, were selected the total polyphenolics, ascorbic acid and β–carotene content who exert an antioxidant effect, they have an important role in cellular balance.

In order to estimate the daily dose of total polyphenolics, ascorbic acid and β–carotene ingested by eating meat reformulated products have been used the data presented by [20] for estimating the amount of meat products consumed by the population.

Meat products considered in this study are: pork salami, pork sausage, pork ham and pork roulade. Mathematical equation used to calculate estimated daily dose of total polyphenols, ascorbic acid and β-carotene ingested by eating meat products is:

$$V_{DZ} = \frac{V_P \cdot V_A \cdot C_S}{100 \cdot 1000} \quad (1)$$

where:

V_{DZ} is the theoretical amount of total polyphenols, ascorbic acid and β–carotene by eating meat products, μg

V_P – amount of meat products consumed by respondents, g/day

V_A – amount of total polyphenols, ascorbic acid and β–carotene added to 100g of raw material, μg/100g

C_S – specific consumption of meat products, g /g

RESULTS AND DISCUSSIONS

In order to optimize nutritional meat products it has been carryed out a preliminary study to establish the vegetal raw materials rich in macro- and micronutrients to supplement nutritional profile of meat. In this study there were used the following vegetal raw materials: mushrooms (for the high content of β-glucans), nuts (due to lipids profile), sea buckthorn berries and rose hip (for high content in total polyphenolics, ascorbic acid, β–carotene and other micronutrients).

The current study aimed to determine the medium physico-chemical composition for mushrooms, nuts (Table 1), sea buckthorn berries and rose hip (Table 2). All the results were carried out in triplicate. It can be noticed the medium content, 64.44% dm of fat for nuts, fat consisting mainly of polyunsaturated fatty acids omega–6 and omega–3 (PUFA), which are essential in daily diet [1], [2].

Nutritional profile of mushrooms consist primarily in carbohydrates in a proportion of 62% dm and proteins in a proportion of 25% dm. These components ensure the functional potential of mushrooms in meat products by the content of β-glucans [17] and immunomodulatory proteins [16], respectively.

Sea buckthorn berries and rose hip have been choosed for the reformulation of meat products due to their antioxidant capacity given by ascorbic acid (253 mg/100g in sea buckthorn berries; 68.04 mg/100g in rose hip), β-carotene (10.3 mg/100g in sea buckthorn berries; 1.29 mg/100g in rose hip) and polyphenolics (196.89 mg/100g in sea buckthorn berries; 143.17 mg/100g in rose hip).

Another objective of this study was to simulate nutrient enrichment of meat products, taking into account the consumption of such products by population. This simulation was based on data presented by [20] on meat products consumption for the segment of the population 25-34 years women and men.

It was considered that rose hip and sea buckthorn berries is added in 1% to the raw material. In this study was not taken into account the possible loss of micronutrients during the manufacturing process of meat products.

Table 1 Physico-chemical composition of nuts (*Juglans regia L.*) and mushrooms (*Agaricus bisporus L.*)

Parameter/Compound	Nuts (*Juglans regia L.*)	Mushrooms (*Agaricus bisporus L.*)
Moisture, %	2.24 ± 0.05	91.51 ± 0.15
Fat, % dm	64.44 ± 6	2.7 ± 0.17
Protein, % dm	6.13 ± 0.4	25 ± 0.12
Carbohydrate, % dm	-	62 ± 0.15
Minerals, % dm	-	9.75 ± 0.17

All values are mean ± standard deviation of three replicates
dm = dry matter

Table 2 Moisture, nutrients composition and bioactive compounds of the sea buckthorn berries (*Hippophaë rhamnoides L.)* and rose hip (*Rosa canina L.*)

Parameter/Compound	Sea buckthorn berries (*Hippophaë rhamnoides L.)*	Rose hip (*Rosa canina L.*)
Moisture, g/100g	76.16 ± 2.95[1]	48.68 ± 0.91[1]
Carbohydrate, g/100g	4.19 ± 0.25	93.16 ± 0.18
Fat, g/100g	1.73 ± 0.12	0.65 ± 0.04
Protein, g/100g	1.15 ± 0.31	2.72 ± 0.05
Ash, g/100g	0.83 ± 0.03	3.47 ± 0.20
Ascorbic acid, mg/100g	253 ± 26.63	68.04 ± 1.11
β – carotene, mg/100g	10.30 ± 0.70	1.29 ± 0.26
Total polyphenols, expressed as gallic acid, mg/100g	196.89 ± 9.3	143.17 ± 5.25

All values are mean ± standard deviation of three replicates

Figure 1 and Figure 2 show the amount of total polyphenolics which may be found in meat products consumed by women and by men, respectively, aged between 25 and 34 years. The amount of total polyphenolics is influenced by the quantity of consumed product, the percentage of sea buckthorn berries / rose hip added and not least the specific consumption value.

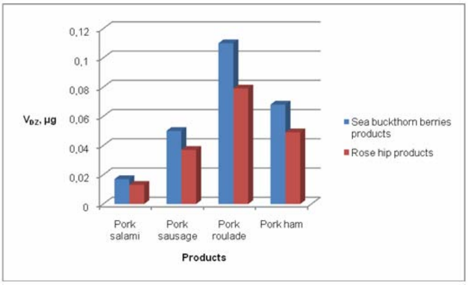

Figure 1 The amount of total polyphenolics estimated in meat products consumed by women

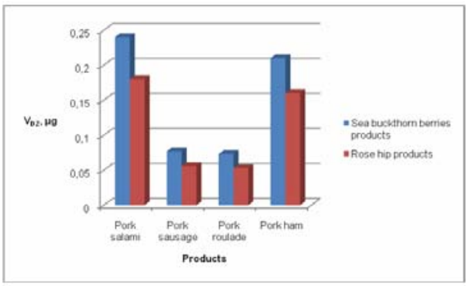

Figure 2 The amount of total polyphenolics estimated in meat products consumed by men

The values obtained and presented in graphs are directly proportional to consumer preferences. From Figure 1 it can be seen that women aged 25-34 years consume mainly pork roulade and pork ham, products were the content of total polyphenolics could be of 0.11 µg or 0068 µg.

Figure 2 shows that men consume greater quantities of pork sausage and pork ham, products in which the estimated amount of total polyphenolics vary between 0.15 and 0.24 µg.

Figures 3 and 4 show the content in ascorbic acid of meat products consumed by women and men.

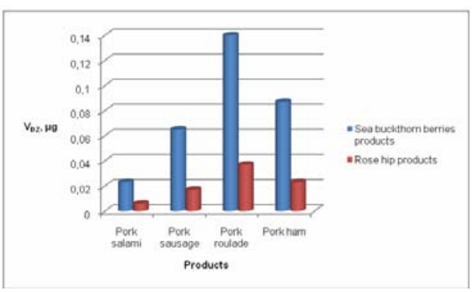

Figure 3 The amount of ascorbic acid estimated in meat products consumed by women

From Figure 3 it can be estimated that the highest dose of ascorbic acid ingested by women aged 25 to 34 years is ensured by eating pork roulade supplemented with sea buckthorn berries (about 14 µg).

Figure 4 shows that the dose of ascorbic acid ingested by men is between 0.025 µg (provided by eating pork sausages supplemented with rose hip) and 0.3 µg (provided by eating pork salami supplemented with sea buckthorn berries).

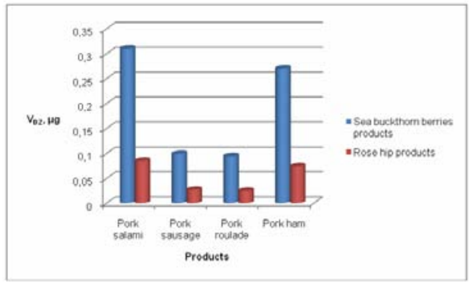

Figure 4 The amount of ascorbic acid estimated in meat products consumed by men

β-carotene content that may be present in meat products consumed both by women and men aged between 25 and 34 years is shown in Figures 5 and 6. From Figure 5 it can be see that a high content of β-carotene may be estimated for pork roulade (0.0057 µg), value that is directly proportional to the consumer preference of this product.

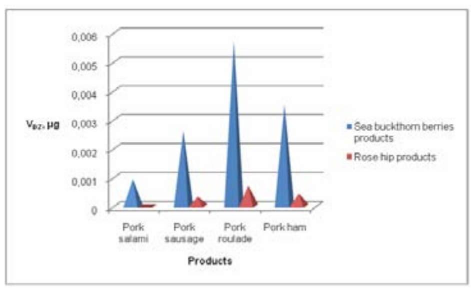

Figure 5 The amount of β-carotene estimated in meat products consumed by women

By analising the Figure 6 it can be determined the amount of β-carotene that men could ingest by eating reformulated meat products. This ranges between 0.00051 µg in pork sausages supplemented with rosehip and 0012 μg in pork salami supplemented with sea buckthorn berries.

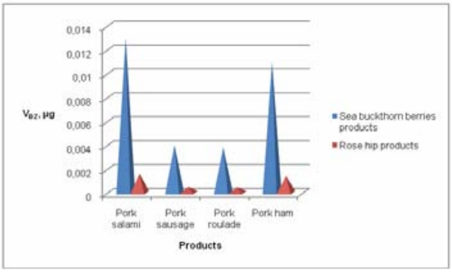

Figure 6 The amount of β-carotene estimated in meat products consumed by men

CONCLUSIONS

By the present study there have been reached the following conclusions:

- macro- and micronutrients content from vegetal sources analysed comply with the data presented in the scientific literature;
- the amount of total polyphenols ingested with meat products are between 0.037-0.11 μg/day for women and between 0.053-0.24 μg/day for men;
- the higher values of ascorbic acid were estimated for pork roulade (0.14 μg/day) consumed by women and pork salami (0.31 μg/day) product that was consumed mostly by men;
- the amount of β-carotene ingested with meat products was estimated between 0.00011-0.0057 μg/day for women and between 0.00051-0.013 μg/day for men;

Theese findings allow further research for more complex characterizing the products with these additives, in order to diversify wide assortment of reformulated meat products with functional potential.

ACKNOWLEDGEMENTS

The work of researchers was supported by CNCSIS-UEFISCDI Romania as National Project II no. 115/2012 – OPTIMEAT.

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