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ASSESSMENT OF SOME NUTRIENTS IN BAKERY PRODUCTS

Evelina GHERGHINA[1], Florentina ISRAEL-ROMING[1], Daniela BALAN[1], Gabriela LUTA[1], Vasilica SIMION[1], Marta ZACHIA[2]

[1] University of Agronomic Sciences and Veterinary Medicine, Faculty of Biotechnology/ Centre for Applied Biochemistry and Biotechnology BIOTEHNOL, 59 Marasti Blvd., 11464 Bucharest, Romania, email: eveghe@yahoo.com
[2]National R&D Institute for Food Bioresources – IBA, 6 Dinu Vintila Street, 0201102 Bucharest, Romania, email: marta.zachia@bioresurse.ro

Corresponding author Daniela BALAN: balan.dana@gmail.com

Abstract

Bakery products constitute an important part of the human diet, providing a high quantity of carbohydrates, but also proteins, dietary fibres, B group vitamins and minerals. Consumption of whole grain foods means high intake of dietary fibre and micronutrients, which has been associated with a reduced risk of coronary heart disease, diabetes, obesity and some forms of cancer. The aim of the present study was to appreciate the nutritive value of some bakery products by assessment of content in thiamine and α-tocopherol. The researches were performed on common products made with wheat or rye flour and on some enriched products obtained by adding different ingredients of vegetal origin, such as olives, onion, garlic or seeds. These supplementary ingredients were used to improve the taste and to diversify the range of bakery products. In the same time, their addition results in obtaining healthier food. α-Tocopherol content was analysed by HPLC method and thiamine content was determined by spectrofluorometric method. The obtained results showed a higher content of thiamine in the enriched products comparing to the traditional ones. Moreover, the analysis indicated an improvement of α-tocopherol content, although the bakery products usually contain low amounts of this vitamin.

Key words*: bread, biscuits, thiamine, α-tocopherol.*

INTRODUCTION

Bakery products constitute an important part of the human diet, widely accessible, providing a high quantity of carbohydrates, proteins, dietary fibres, vitamins of B group and minerals.

Lately, there is an increased concern for incorporating bioactive ingredients in popular foods such as bread and bakery products, because of growing interest of consumers for healthier food (Sivam et al., 2010). As result, there is a high demand for functional foods with large amounts of antioxidants and dietary fibres, especially because they are associated with health benefits (Pelucchi et al., 2004; Arts et al., 2005; Scott et al., 2008). Since the endogenous fibre polysaccharide content in white wheat flour is only 2-4%, using whole grains as source of dietary fibre in bread would raise the health profile of the final products (Pelucchi et al., 2004; Scott et al., 2008, Dikeman et al., 2006).

Vitamin B_1, also known as thiamine, plays a major role in the obtaining of energy from dietary carbohydrates and fats, so that deficiency of this nutrient may influence the functions of most of body organs. Severe and prolonged deficiency has been reported to affect the nervous system, the heart, and digestive function, among other areas. Most foods contain small amounts of thiamine, but good dietary sources of thiamine include whole-grain or enriched cereals and rice, legumes, wheat germ, bran, brewer's yeast. Thiamine is known to occur in the outer integuments and germ of cereal grain. In wheat grain, the endosperm represents 80–85% of grains dry mass, but contains only 3% of the total thiamine (Kalnina et al., 2014). The highest proportion (about 80%) of thiamine is found in the external layers of wheat grain. Unfortunately these are missing in white flour (Batifloulier et al., 2006). Whole wheat flour, one of the most common and important whole grains, retains wheat bran and germ and acts as a rich source of

dietary fibre, vitamins, minerals and antioxidants (Wang et al., 2014, Liyana-Pathirana and Shahidi, 2007).

Cereal grains contain also intrinsic phenolic antioxidants. Free radicals derived from a wide range of biological reactions in the body can damage essential biomolecules. For example, lipid peroxide radicals have been associated with chronic degenerative diseases such as cancer, inflammatory, aging, cardiovascular and neurodegenerative disease (Shahidi et al., 1995; Arts et al., 2005). Natural antioxidants such as flavonoids, tocopherols, and phenolic acids may inhibit lipid peroxidation in food and improve food quality (Fan et al., 2007; et al., 2007; Wojdyło et al., 2007).

Vitamin E is the term for a group of tocopherols and tocotrienols, of which α-tocopherol exerts the highest biological activity and is exclusively obtained from the diet. Nuts, seeds, vegetable oils are among the best sources of vitamin E and significant amounts are available in wheat germ oil, green leafy vegetables and fortified cereals. Vitamin E is the major lipid-soluble antioxidant in the cell antioxidant defence system which protects tissues against the damaging effects of free radicals. Due to the potent antioxidant properties of tocopherols, their impact in the prevention of chronic diseases believed to be associated with oxidative stress has been studied and beneficial effects have been demonstrated (Brigelius-Flohe et al., 1999).

Consumption of whole grain foods means high intake of dietary fiber and micronutrients, which has been associated with a reduced risk of coronary heart disease, diabetes, obesity and some forms of cancer (Anderson et al., 2009).

The aim of the present study was to appreciate the nutritive value of some bakery products by assessment the content in thiamine and α-tocopherol. The researches were performed on traditional products made with wheat or rye flour and on some enriched products obtained by adding different ingredients of vegetal origin, such as olive oil, onion, garlic or different seeds. These supplementary ingredients were used to improve the taste and to diversify the range of bakery products. In the same time, due to their content in thiamine and α-tocopherol, their addition results in obtaining healthier food.

MATERIALS AND METHODS

Samples

The determinations were performed on traditional products, made with wheat or rye flour, and on some enriched products obtained by adding different ingredients of vegetal origin. Thirteen samples of such bakery products were analysed in order to determine the content in thiamine and α-tocopherol. The determinations were performed in triplicate for some type of bread (made of white or whole-wheat flour, of rye flour and of wheat flour enriched with different vegetal ingredients) and four types of biscuits. The extractions of analysed compounds were conducted according to the protocol used for each determination.

Methods

Determination of thiamine content

Sample preparation. The bakery products were dried and then finely grounded. For extraction of thiamine, the sample was digested with diluted sulphuric acid on a boiling water bath for 15 min and subsequently treated with an enzymatic mixture, containing phosphatase and protease, in order to release the thiamine from the natural ester and protein bonds.

Analysis method. Thiamine content was analysed using a fluorometric method based on the oxidation of thiamine with oxidizing reagent (potassium ferricyanide in alkaline solution) to fluorescent thiochrome. The thiochrome obtained is extracted with isobutyl alcohol. The intensity of fluorescence of the isobutyl alcohol extract is compared with that of the standard solution (100 μg/ml thiamine). Also a blank (control) is prepared by adding of sodium metabisulphite in the sample. The intensity of fluorescence is measured with a JASCO FP-6300 spectrofluorometer and fluorescence value of the blank test is subtracted from that of the sample extract.

Determination of α-tocopherol content

Sample preparation. The first step for extraction was consisted in saponification with 11% KOH ethanolic solution at 80°C, for 15 minutes. Ascorbic acid was used for preventing vitamin E oxidation. α-Tocopherol was extracted with 4 ml iso-octane by vortexing for 2 minutes. After separation of the two phases 1 ml iso-octane extract was evaporated using a centrifugal evaporator and the fatty residue was reconstituted in 0.5 ml methanol. All the samples were prepared and analysed in triplicates.

Analysis method. Separation of tocopherols was carried out by RP-HPLC method, using a Waters Alliance system, with UV detection. The separation was performed with C8 Symmetry column and a mobile phase consisting in methanol + acetonitrile + water solution (45:45:10, v/v/v), with 1 ml/min flow rate. The data were achieved and processed with EMPOWER 2.0 specialized software. Calibration curve was obtained using 56.22 µg/ml α-tocopherol (Sigma-Aldrich) standard solution and the results were calculated and expressed as mg α-tocopherol in 1 g product.

RESULTS AND DISCUSSIONS

In its natural state, wheat is a good source of vitamins B_1 and E. However, because most of these biocompounds are concentrated in the outer layers of the wheat grain, a smaller proportion is found in the flour at the end of the milling process. Moreover, the stability of vitamins in processed products is reduced because its sensitivity to heat, oxidising and reducing agents, light, and other kinds of physic and chemical factors. Yet it seems that during cooking the temperature inside the bakery product is significantly lower although baking temperatures are high (over 200°C), therefore over 70 % of the vitamins remain unaltered (Cort et al., 1976).

The biochemical analysis performed to determine the B_1 vitamin content (figure 1) revealed high value in rye bread (4.67 mg/kg) followed by whole-wheat bread (4.59 mg/kg) and whole-wheat mixed seeds rolls (3.19 mg/kg). By comparison, lower thiamine content was determined in the white bread (3.05 mg/kg), as expected due to the removal of grains outer layers by milling. These results are supported by researches performed by other authors. According to the scientific literature, higher B_1 vitamin content was obtained in whole grain flour (4.8 mg/kg) comparing with wheat flour 550 type (2.5 mg/kg); similar vitamin B_1 content was found in whole grain rye (4,2 mg/kg) (Kalnina et al., 2014).

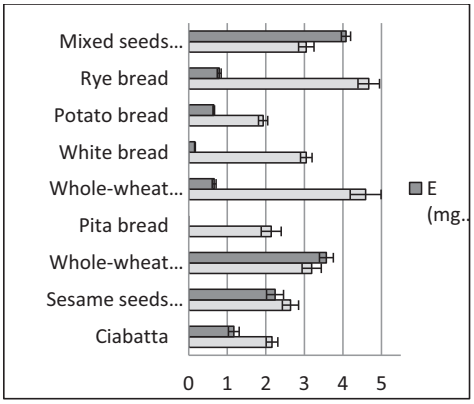

Figure 1. Amounts of vitamins B_1 and E in the analyzed bakery products

Smaller values of thiamine content were measured in ciabatta (2.16 mg/kg) and pita bread (2.14 mg/kg), some bakery specialties used in many Mediterranean, Balkan and Middle Eastern cuisines (figure 1). Ciabbatta is an Italian white bread made from wheat flour, water, salt, olive oil and yeast, while pita is a soft, slightly leavened flatbread baked from wheat flour. It seems that using highly refined white flour for obtaining of bakery products resulted in decreasing of vitamin B_1 content.

The addition of some vegetal ingredients had a different influence: the sesame seeds contributed to the enrichment in B_1, while potatoes in bread determined a reduction of vitamin B_1 amount in the finished product. So, the measured values of vitamin B_1 ranged between 2.64 mg/kg in sesame seeds rolls and 1.93 mg/kg in potato bread. Indeed, the scientific literature reports higher values of thiamine in the whole sesame seeds (7.1-

8.3 mg/kg) (Makinde et al., 2013) compare to those determined in potatoes (0.29-1.32 mg/kg) (Goyer et al., 2011). Although a part of the thiamine content losses occur during baking, it appears that ingredients containing large amounts of B_1 contribute at enrichment of finished bakery products.

Also the biscuits made by dough supplementation with potato flakes registered lower amounts of vitamin B_1 (1.95 mg/kg) compared to sweet biscuits, containing 2.33 mg/kg B_1 (figure 2). However, significant increase of the B_1 amount in biscuits (3.76 mg/kg B_1) was registered by addition of garlic, beside potato flakes.

The present results correspond to the data reported regarding the content in B_1 of the added ingredients: potatoes (0.29-1.32 mg/kg), garlic (3.42-15.28 mg/kg) (Al-Timimia et al., 2013).

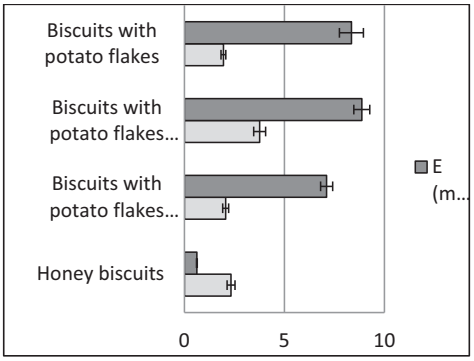

Figure 2. Amounts of vitamins B_1 and E in some types of biscuits

Although vitamin E is present in high amounts in wheat germ, the scientific literature indicates only small amount remained in the wheat flour due to the absence of the germ and bran fractions in the refined flour. Furthermore, the content of vitamin E in wheat flour decreases in time: about one-third of vitamin E amount is lost after one year of storage (Nielsen et al., 2008).

As concerning the vitamin E content in the analysed samples (figure 1), small values were registered in the bakery products made with highly refined flour: 0.16 mg/g vitamin E in white bread, while in pita bread it was not detectable by the used analysis method.

Higher value of vitamin E content were measured in whole-wheat bread (0.66 mg/g), as expected given the data from cited literature which indicate that the germ fraction contained by this type of flour is riched in vitamin E (16 times higher amount of vitamin E than in any other fraction) (Engelsen et al., 2009). Besides, also the total lipids content in these bakery products are correlated with vitamin E amounts: it was determined a higher value in whole-wheat bread (1.81 % lipids) compared to the one measured in white bread (1.46 % lipids) or pita (1.42 % lipids).

Nevertheless significant increase of α-tocopherol was registered in the bakery products supplemented with different ingredients. Thus, addition of olive oil in ciabatta resulted not only in a higher content of total lipids (2.45 g %), but in a higher amount of vitamin E determined in this bakery specialty (1.17 mg/g) (figure 1). These results correspond with the high concentrations of vitamin E found in most of the samples of Greek virgin olive oils selected from various regions, values ranging between 98-370 mg/kg (Psomiadou et al., 2000; Escuderos et al., 2009). Also, the different kind of seeds added in some bakery product resulted in a rich content in total lipids (between 5-6 %), and, in the same time, contributing to enrichment in vitamin E of the finished products. According to figure 1, large amount of vitamin E were detected: 4.08 mg/g in mixed seeds bread, 3.57 mg/g in whole-wheat mixed seeds rolls, 2.64 mg/g in sesame seeds rolls.

The analysed varieties of salted biscuits (fig.2) showed higher values of vitamin E content in comparison with the mentioned bakery products, ranging between 7.11 mg/g in potato flakes and onion biscuits and 8.87 mg/g in potato flakes and garlic biscuits. As expected, the total lipids content was higher in biscuits (between 18.33 and 18.66 %), considering the dough recipe containing fat and eggs, which also can provide vitamin E. However, some of the vegetal ingredients

added in biscuits (garlic) brought a contribution to increasing the amount in vitamin E, which was lower in the potato flakes biscuits (8.35 mg/g).

CONCLUSIONS

Bakery products made by using highly refined white flour (white bread, pita bread, ciabatta) contained lower amounts of vitamin B_1 and vitamin E compared with those containing whole-wheat flour or rye flour. However, ciabatta is an exception regarding the vitamin E content, which is high due to the olive oil added.

Addition of supplementary ingredients (olive oil, garlic, onion, mixed seeds) to some types of bakery products resulted in obtaining B_1 and E vitamins enriched food.

These supplementary vegetal ingredients were used to improve the taste and to diversify the range of bakery products, aiming to be an encouragement and an orientation for healthier food consumption.

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