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THE USE OF TARTARY BUCKWHEAT WHOLE FLOUR TO INTRODUCE RUTIN IN PREVENTIVE AMOUNTS IN BREAD TYPICAL OF THE REGION OF TUSCANY (CENTRAL ITALY)

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Thanks to the high rutin content of its grain and whole flour, tartary buckwheat can be proposed as an ingredient of new food preparations containing effective amounts of this bioactive compound credited to exert a growing multiplicity of health beneficial properties. In this respect, most dietary supplement preparations, containing around 50 mg of rutin, are suggested as the daily preventive dose. Considering that the content of rutin of tartary buckwheat whole flour usually ranges between 1000 up to 2000 mg/100 g dry weight, the introduction of a low percentage of this ingredient in the original recipe would allow to reach such amount in a food largely consumed like bread. Preliminary result would indicate that, in the preparation of a typical Tuscany bread, a certain amount (up to 20%) of wheat flour can be replaced by a mixture of common and tartary buckwheat whole flour so to allegedly secure an intake of 50 mg of rutin through the average daily consumption of bread (about 200 g) in addition to an appreciable content of beneficial buckwheat protein and amylase resistant starch. However, efforts are to be dedicated to identify the most suited wheat flour in order not to impair texture, taste and acceptability of the bread so amended. In addition most of the rutin was not recovered in the final products, either degraded to quercetin or lost during preparation and baking processes. Research are underway to verify the extent of rutin degradation to quercetin by the hydrolyzing enzymes, known to be present in tartary buckwheat grain, during the phase of dough formation and successive leavening and to workout processing conditions apt to control such a phenomenon.

Keywords: *Fagopyrum tataricum*, bioactive compounds, functional food

1. Introduction

Bread is one of the main staples largely consumed in countries like Italy. Because of the crescent attention paid to the eventual negative side effect of refined foods consumed in the Western Countries, as for instance diabetes and cardiovascular disorders, there seems to be a scope in improving the nutritional characteristics of this aliment by adding health beneficial compounds as those present in the grain of buckwheat. Protein, starch, fibre, minerals and rutin are, in fact, the components of interest of buckwheat grain.

Of the two buckwheat species grown as crop, common buckwheat (*F. esculentum*), usually utilized in food preparations, presents low level of flavonoid rutin (Kitabayashi *et al*., 1995a). Tartary buckwheat, on the contrary, presenting quite high levels of rutin in the grain (Kitabayashi *et al*., 1995b) is a good source of this bioactive compound as would be buckwheat herbs (Fabian *et al*., 2003). However, the handling of the last material may not be as simple as that of the grain made into whole flour.

Buckwheat proteins have anticholesterolemic properties (Kayashita *et al*,. 1995) and starch, resistant to amylases, helps maintaining a low glycaemic index (Skrabanja *et al*,. 2001). However, it is the rutin to elicit the majority of the health beneficial properties attributable to the consumption of buckwheat (Christa and Soral-Śmietana, 2008).

Depending on the amount, rutin may exert a curative function (>500 mg/d) or just a useful preventive action (40-100 mg/d), the last being the amount present in the majority of the dietary supplements advertised for preventive and maintenance well-being.

Because of the low content of rutin, common buckwheat flour has not the potential to provide meaningful amounts of this bioactive compound when added to wheat flour in low percentage in order not to prejudice bread acceptability. This objective is certainly within the reach if tartary buckwheat is utilized instead. Trying to improve nutritional and health beneficial characteristics of a typical bread of the Region Tuscany of Central Italy, a mixture of whole flour of tartary buckwheat (rutin) and common buckwheat (protein starch, fibre, minerals) was utilized. The main objective was to secure the intake of about 40 mg of rutin on an average daily consumption of about 200 g of bread. The other buckwheat bioactive components present in common buckwheat should provide an additional health bonus so that this Tuscany bread might acquire the characteristics of a functional food and eventually be promoted to the level of FOSHU (Foods for Specified Health Use).

2. Materials and methods

A typical bread of the Region Tuscany was prepared replacing twenty percent of wheat flour with common buckwheat whole flour (16%) and tartary buckwheat whole flour (4%). Effective amounts of rutin (*F. tataricum*) and some protein with hypocholesterolemic activity and starch resistant to amylase (*F. esculentum*) were expected to be made available through the combination of whole flour of the two *Fagopyrum* species.

Furthermore, the whole flour of *F. tataricum* was either pre-treated or not in an oven at 80°C for 30 minutes, in the attempt to inactivate the rutin degrading enzymes known to be present in tartary buckwheat grain. Traditional bread prepared utilising only wheat flour served as control.

The ingredients used were: wheat flour 3.440 g; common buckwheat whole flour 690 g; tartary buckwheat whole flour 170 g; salt 20 g; soft wheat sour dough 1.200 g; water as required for dough making.

Soft wheat sour dough, left in bulk pre-fermentation for 12 hours, was added to the other ingredients (wheat flour, common buckwheat whole flour, tartary buckwheat whole flour, salt and water). The salt was added, in spite of the Tuscany tradition, in order to enhance buckwheat flavour. The resulting mix was utilised to prepare loaves around 20 cm in length and 8 cm in diameter. The dough portions so obtained were proofed for 4/5 hours and subsequently baked at 190-200°C for 45-50 minutes

Altogether, to obtain the baked loaves took between 4 to 5 hours. Once ready the loaves had a weight of approximately 300 g. Bread was then analysed for the content of rutin and quercetin by the high pressure liquid chromatography (HPLC) method following the procedure previously described (Brunori and Vegvari, 2007). Quercetin was taken into account to evaluate any rutin degrading activity of rutin hydrolyzing enzymes known to be present in the tartary grain.

3. Results and discussions

The results of the analysis of rutin and quercetin contents of wheat flour and buckwheat whole flour utilized in the present trial, are shown in Table 1. Neither rutin nor quercetin could be detected in wheat flour. No quercetin was observed in common buckwheat whole flour. Appreciable amount of quercetin was instead present in tartary buckwheat whole flour no matter the heat treatment.

Table 1. Rutin and quercetin contents of wheat flour and common and tartary buckwheat whole flour.

	Rutin (mg/100 g DW)	Quercetin (mg/100 g DW)
Wheat flour	0.00 ± 0.00	0.00 ± 0.00
Common buckwheat whole flour	18.96 ± 0.44	0.00 ± 0.00
Tartary buckwheat whole flour	1091.43 ± 8.90	1.88 ± 0.12
Tartary buckwheat heat-treated whole flour	1148.51 ± 32.49	2.73 ± 0.01

DW: dry weight

The rutin and quercetin content of control and bread containing either heat-treated (sample1) or not (sample 2) whole flour of common and tartary buckwheat are presented in Table 2.

As expected no rutin nor quercetin was observed in the control bread. Most of the rutin was degraded to quercetin no matter the heat treatment. The sum of rutin and quercetin was somewhat lower than the expected amount of the rutin supplied to the wheat flour through the buckwheat whole flour.

Table 2. Rutin and quercetin contents of breads containing common and tartary buckwheat whole flour. Tartary buckwheat whole flour was either (sample 1) or not heat-treated in an oven at 80°C for 30 minutes (sample 2). Control bread was made of plain wheat flour.

	Wheat flour	Common buckwheat whole flour	Tartary buckwheat whole flour	Rutin (mg/100g DW)		Quercetin (mg/100g DW)	
				expected	observed	expected	observed
Control	100%	0%	0%	0.00	0.00 ± 0.00	0.00	0.00 ± 0.00
Sample 1	80%	16%	4%	47.37	6.45 ± 0.25	0.11	15.81 ± 0.21
Sample 2	80%	16%	4%	45.33	4.44 ± 0.18	0.07	17.37 ± 0.11

The appearance of bread loaves is provided in Figure 1.

Figure 1. Typical breads of the Region Tuscany in which 20% of the wheat flour was substituted with buckwheat whole flour (16% common buckwheat and 4% tartary buckwheat). Tartary buckwheat whole flour was either (left) or not (right) heat-treated at 80°C for 30 minutes.

Adding buckwheat whole flour in a proportion of 20%, as in the present trial, results in a somewhat reduced loaf volume and crumb appealing texture. If the objective of a supplement of 20% buckwheat whole flour is to be attained to keep the benefit of buckwheat protein and starch, efforts are to be spent to identify high quality (strong gluten) wheat flour able to preserve a satisfactory loaf volume and a pleasant crumb structure.

The degradation of rutin to quercetin, that substantially occurred regardless of the heat-treatment, points to the need of working out processing conditions which may effectively attenuate the functionality of the rutin degrading enzymes whose activity is likely enhanced by the dough preparation and the extended leavening period (presence of water and suitable temperature).

4. Conclusions

Whenever the bread texture might not be improved by utilizing wheat flours of superior baking quality, it will be still possible, by lowering the percentage of common buckwheat and maintaining the proportion of tartary buckwheat, to provide bread with effective content of rutin. However, in this case still the problem remains of rutin degradation to quercetin to be worked out.

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