

**THE USE OF *FAGOPYRUM TATARICUM* GAERTN. WHOLE FLOUR TO CONFER
PREVENTIVE CONTENTS OF RUTIN TO SOME TRADITIONAL TUSCANY BISCUITS***

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Received 9 April 2009

Revised 16 May 2009

To meet the growing interest for new foods that may be regarded as functional aliments, of particular interest appears the utilization of the grain of *Fagopyrum tataricum*. The high content of rutin available in the grain and whole flour of this species, in fact, offers the opportunity to introduce in the food recipes effective amounts of this bioactive compound.

Rutin is credited with a growing multiplicity of health beneficial properties that can be reasonably secured through the preventive nutrition approach. In this respect, the daily dose of rutin suggested by most dietary supplement preparations is around 50 mg/day. The use of *F. tataricum* whole flour, where the rutin content usually ranges between 1000 up to 2000 mg/100 g dry weight, allows to reach such an amount with a low percentage introduction of this ingredient in the original recipe. Higher contents of rutin are found in the herb of cultivated species of buckwheat (*F. tataricum* and *F. esculentum*). However, the handling of this material may not be as simple as that of the grain made into whole flour. Preliminary results would indicate that an intake of 50 mg of rutin with a single meal (breakfast in this case) can be feasible by adding tartary buckwheat whole flour to some traditional Tuscany biscuits without impairing texture, taste and acceptability.

In spite of the presence of rutin degrading enzymes, known to be present in tartary buckwheat grain, it would appear that just a negligible degradation of rutin to quercetin occurs during the phase of dough preparation and baking process so that most of the rutin present in the whole flour can be recovered in the biscuits.

Key words: Tartary buckwheat, bioactive compounds, functional food.

1. Introduction

Foods are meant to provide calories (sugar) and essential substances (amino acids, fats, vitamins and minerals) necessary for growth and well being. In western Countries, however, a concern is being registered due to the growing evidence that the insurgence of ailments like diabetes, cardiovascular diseases and even cancer, could be promoted by the kind and amount of foods assumed.

In this respect, a number of dietary supplements mainly based on bioactive compounds of plant origin, expected to help in keeping a satisfactory health condition, are currently advertised. Particularly appealing appears a novel class of food preparations known as FOSHU (Food for Specified Health

* Paper presented at the International Symposium *Euro - aliment 2009*, 9th – 10th of October 2009, Galati – ROMANIA

Use) that are supposed to prevent and alleviate metabolic unbalance like, for instance, hypercholesterolemia, obesity, diabetes, vascular disorders, etc.

There is a large number of plant species known to contain useful bioactive compounds like curcuma longa, cardamom, fenugreek, tea, onion, garlic, to cite a few, which are mainly utilized as condiments or beverages (green tea).

Among staple crops, soybean is the one credited of several health beneficial properties as many evidence would indicate. The consumption of soybean, however, is strongly related to the oriental culture and only in the last decades it is struggling to find the way towards the European Countries. However, buckwheat is actually the sole food crop which is particularly appropriate to improve the quality of many of the traditional foods of the European countries and several of these have the chance to be promoted to the role of FOSHU as for instance bread, biscuits and pasta.

Buckwheat is not only a food crop but possesses a lot of beneficial health properties thanks to several components of its grain as protein, starch, minerals and fibres. However, it is the component rutin which makes buckwheat a unique cereal grain. Rutin is for sure one of the most beneficial plant bioactive compounds as the large and growing scientific literature would prove (Christa and Soral-Śmietana, 2008).

Unfortunately, the content of rutin in the grain of *Fagopyrum esculentum* (common buckwheat), the species commonly utilized in food preparations, is too low to provide the amount of rutin (40 -100 mg/d) necessary to secure preventive activity with respect to the potential expected health benefits: reduction of capillary fragility, anti-inflammatory properties, antihyperglycemic activity, antimutagenic activity, anticancer activity, mitigating effect of diabetes consequences. To confer food preparations effective contents of this compound, the use of the rutin rich buckwheat herb has been considered (Fabjan N. *et al.*, 2003).

However, the low content of rutin in the grain of common buckwheat (Kitabayashi *et al.*, 1995a) can be amended if *Fagopyrum tataricum* (tartary buckwheat) is taken into account. The content of rutin in tartary buckwheat is in fact almost 100 times higher than that of common buckwheat (Kitabayashi *et al.*, 1995b).

Different proportions of common and tartary buckwheat were thus utilized in an attempt to confer to some traditional Tuscany biscuits the characteristics of FOSHU by securing through the assumption of 5-6 biscuits of 9g each (the intake of a typical Italian breakfast) up to 40 mg rutin. The use of tartary buckwheat whole flour would appear more simple than obtaining high quality and safe buckwheat herb.

2. Material and method

Traditional Tuscany biscuits were prepared following the original recipe and replacing twenty percent of wheat flour with three different combinations of whole flour of two buckwheat species (*F. esculentum* and *F. tataricum*).

The combination of both *Fagopyrum* species was utilised to provide to the biscuits effective amounts of rutin (*F. tataricum*) and protein with hypocholesterolemic activity and starch resistant to amylase (*F. esculentum*).

The three combinations were as follows:

1. Wheat flour 80%, common buckwheat whole flour 16% and tartary buckwheat whole flour 4%;
2. Wheat flour 80%, common buckwheat whole flour 12% and tartary buckwheat whole flour 8%;
3. Wheat flour 80%, common buckwheat whole flour 8% and tartary buckwheat whole flour 12%.

Furthermore, the whole flour of tartary buckwheat was either or not pre-treated in an oven at 80°C for 30 minutes, in the attempt to deactivate the rutin degrading enzymes known to be present in tartary buckwheat grain, leading to a total number of 6 different experimental combinations. Cookies prepared following the traditional recipe served as control.

The ingredients were mixed in three successive steps:

1. sugar, anhydrous butter, margarine, milk powder, vanillin extract and orange flavour;
2. eggs, salt and water;
3. wheat flour, common buckwheat wholemeal, tartary buckwheat wholemeal and baking powder.

The nutritional profile of the resulting dough, expressed as percent of dry weight, was as follows:

- protein 8.6 %;
- carbohydrates 63.4 %, of which simple sugars 26.0%;
- fats 23.8 %, of which saturated 8.2%;
- dietary fibre, 2.7%;
- sodium chloride, 1.10%.
- energy content: 502 Kcal per 100 g DW equal to 2103 Kjoule

The dough was immediately utilised to prepare circular shaped biscuits around 3 cm in diameter placed on a tray (one for each different combination) and baked in an oven at 175°C for 13 minutes.

The preparation of the biscuits from the adding of the buckwheat wholemeal to the baking took between 15 to 20 minutes (time elapsed for the action of rutin degrading enzymes).

Once baked the single biscuits had a weight of approximately 9 g each.

Cookies were then analysed for rutin and quercetin by the HPLC method according to the procedure previously described (Brunori and Vegvari, 2007).

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.

Table 1. Rutin and quercetin contents of wheat flour and buckwheat wholemeal.

	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

The appearance of biscuits is provided in Figure 1.



Figure 1. Two different shapes of traditional Tuscany biscuits in which 20% of wheat flour was substituted for buckwheat whole flour (8% common buckwheat and 12% tartary buckwheat).

Data on the rutin and quercetin contents of biscuits whose original recipe was supplemented with different proportions of common and tartary buckwheat whole flour are reported in Table 2.

The data observed would indicate that the rutin amounts recovered in the biscuits were very close to those predicted whereas quercetin was found in minimal traces proving that nearly all the rutin could be preserved without undergoing major processes of enzymatic degradation. No evident effect was in fact noticed between the preparations containing similar amounts of common and tartary buckwheat whole flour while differing only for the heat pre-treatment.

Compared to the expected values the actual amounts of rutin (sometimes) and quercetin (always) appeared slightly higher. This might be the result of an increased rutin solubility, likely due to the high temperature of the baking process and eventually to the fat rich environment, as well as to a reduced degradation of rutin to quercetin.

Table 2. Rutin and quercetin contents of biscuits containing different proportions of common and tartary buckwheat. Tartary buckwheat whole flour was either (samples 1, 3 and 5) or not (samples 2, 4 and 6) pre-treated in an oven at 80°C for 30 minutes. Control was made using only 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%	27.68	27.97 ± 0.95	0.06	3.58 ± 0.16
Sample 2	80%	16%	4%	26.43	26.54 ± 1.16	0.04	2.18 ± 0.01
Sample 3	80%	12%	8%	53.14	52.04 ± 2.81	0.12	6.72 ± 0.13
Sample 4	80%	12%	8%	50.70	48.46 ± 3.11	0.09	10.23 ± 0.62
Sample 5	80%	8%	12%	78.59	72.14 ± 7.16	0.19	14.79 ± 0.44
Sample 6	80%	8%	12%	74.98	70.95 ± 3.38	0.13	13.10 ± 0.30

The combinations with the highest content of tartary buckwheat whole flour (12%) presented a final content of rutin of 72 mg per 100g dry weight. The daily consumption of 50-60 g of these biscuits (6-7 pieces) could guarantee the availability of a preventive dose of rutin (40 mg).

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