

Review

Buckwheat – Challenges in nutrition and technology

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ABSTRACT

The buckwheat market is dominated by common buckwheat, however, the production of Tartary buckwheat is also growing. New varieties of Tartary buckwheat have been registered, and the technology of husking and grinding is being developed. The offer of Tartary buckwheat is becoming more accessible for consumers, and buckwheat products and beverages is strongly increasing in the industry.

The selection of buckwheat dishes in gastronomy is becoming more and more noticeable. Buckwheat festivals, days of buckwheat delicacies, weeks of buckwheat cuisine, and competitions in preparing buckwheat dishes are organized. Traditional and modern media are contributing to the growing popularity of buckwheat. Gluten-free, sugar-free, lactose-free products (including buckwheat) are becoming a food hit. Buckwheat products with less salt are part of the offer of healthy foods.

The present results were presented at the 3th EuroIbra, Prague, Czech Republic in September 2021, and published on the first time in this publication..

1 INTRODUCTION

The nutritional quality as well as other technological properties of buckwheat cause the growing popularity of buckwheat in the diet. In the modern world, the consumption of buckwheat is no longer a way to eradicate hunger, as it was in the past. The reasons for its consumption are the favorable nutritional composition, healthiness, interesting taste, and ever-increasing variety of products and innovative buckwheat dishes in the gastronomic offer. Gluten-free, sugar-free, lactose-free buckwheat products are becoming a food hit (Vombergar et al., 2020). Buckwheat products with less salt are part of the offer of healthy foods.

Due to the high content of flavonoids, Tartary buckwheat can be added to other food products as a functional supplement. Even more, studies on gluten-free buckwheat products, the development of technologies to produce buckwheat products without white sugar (but with other sweeteners), and research on high-value additives in buckwheat products are currently underway.

2 THE BUCKWHEAT PROCESSING TECHNOLOGY

In the diet buckwheat is used technologically processed, husked and ground, prepared at different temperatures and in different media, mostly with water and at high temperatures. The offer of new and innovative industrially made buckwheat products in retail chains is expanding, and the offer of buckwheat dishes in gastronomy and cuisine has been becoming more more varied, especially in the last few years.

2.1 Husking, crushing and milling

Technologically important processes in producing buckwheat products are husking, crushing and milling. By removing the husk, hulled grains (groats) are obtained. Buckwheat groats is husked mostly by hydrothermal processes (pre-cooked). However, the groats are much more brittle if buckwheat is not treated hydrothermally for the husking process. Hydrothermal treatment of grain, which is part of the buckwheat husking process, also results to less digestible starch in buckwheat groats (63–68%), compared to white wheat bread (76%) (Škranja and Kreft, 1998).

Mill fractions of buckwheat are formed by crushing and milling grains and sifting particles. White flour of low granulations is formed from the inner part of the grains

(central endosperm), and semolina or crumb is formed from particles of endosperm and fractions of bran. Buckwheat bran contains the outer layers of hulled grain, as well as fragments of the embryo (sprouts) (Steadman et al., 2001).

In the processes of grinding and husking in mills in Poland (Dietrych-Szóstakova, 2004), 70–76% of hulled grains and 24–30% of husks were obtained from grain. In Slovenia the results in the mill are quite similar. 70-80% of white buckwheat flour is obtained by grinding hulled grain, the rest is dark flour and bran (Vombergar et al., 2021; Vombergar et al., 2018; Hatcher et al., 2008; Škranja et al.; 2004).

The traditional way of milling buckwheat in Slovenia is grinding unhusked buckwheat. The flour yield is 70-75%. Usually, all the fractions formed in the mill are combined into a darker flour, into which a part of the husk is crushed in addition to the grain in the process of gradual crushing, grinding and sifting. As a result, the proportion of minerals (ash) in such flour is higher. The husk is removed in the milling process after the second crushing but can also be removed later and is a by-product. Most flour particles (85%) are smaller than 132 μm , and 2-3% are larger than 200 μm . In the process of grinding, the inclusion of semolina cleaning machines could also be used for cleaning and then separation semolina, which could be further ground and mill into lighter or white buckwheat flour. But for the time being this is not the practice in Slovenia.

According to the valid Slovenian rules on the quality of cereal products (Pravilnik o kakovosti izdelkov iz žit, 1/2014), buckwheat milled products are classified as buckwheat flour, buckwheat semolina or buckwheat crumb. They may contain no more than 3.5% ash in the dry matter and have an acidity level of not more than 5.0.

There is also known a so-called green buckwheat milling, where husked buckwheat is ground. It is about milling thermally untreated buckwheat; we get a greenish buckwheat groats, which is then ground into a flour, lighter in color. This is most typical of the East - Japan, China. However, moisture and heat-treated and husked buckwheat can also be ground. This is supposed to be more typical for the countries of the former Soviet Union. In the process it is obtained flour of a darker color than in green milling, as the heat-treated groats are darker. Both of these procedures are more complicated, as they involve the husking phase, which previously requires calibration of the grains in size so that the husking can take place as

optimally as possible. Yet all of these options are not well researched.

In the study by Vombergar et al. (2017), 67–69% of white flour with a granulation of $\leq 236 \mu\text{m}$ (of which 48% with a granulation of $\leq 100 \mu\text{m}$) was obtained from grain samples of common buckwheat 'darja' and Tartary buckwheat from Luxembourg and 20–21% with granulation of $100 \mu\text{m} < x \leq 236 \mu\text{m}$ and 30–33% of dark flours, bran and husks with granulation $> 236 \mu\text{m}$. Mill fractions with fine light flour colour have a higher starch content.

Different milling fractions may have different amounts of minerals and proteins. Dark flours are generally richer in minerals and proteins than lighter (white) buckwheat flours (Ikeda S. and Yamashita, 1994; Vombergar et al., 2017). White flours contain 6.5–7.2% proteins and dark flour 37.1–38.7% proteins (Hatcher et al., 2008). The ash content of white flour is 0.71–0.78%, in dark, 5.49–5.99% (Hatcher et al., 2008). Flours ground from whole

grains (wholemeal flour) contained 1.86–2.05% ash and 13.4–15.1% proteins (Hatcher et al., 2008).

In technological processes of buckwheat milling, the possibility of controlled composition of nutrients in the milling fractions (e.g. proteins, various minerals) is indicated, insofar as the milling fractions would be separated in the milling processes. This process is not known in the industry yet. The ability to separate buckwheat flour fractions in larger mills depends on milling technologies and is not sufficiently investigated. Individual fractions could be used for different nutritional purposes and for different categories of the population. Knowledge of shares or the quantities of individual milling fractions and subfractions during milling are important in planning the flour mixing technology, as well as in recognizing the composition of these flours. By knowing the composition of the fractions, a strategy can be defined on how to mix buckwheat mill fractions with different granulation and with



Figure 1: Tartary buckwheat bread, made with application of Cream of Tartar as dough rising agent, instead of yeast.

what goal, for example, to obtain fractions with a high amount of proteins or certain amino acids, individual minerals, certain flavonoids, tannins, fiber, etc.

2.2 The development of buckwheat products in the food industry

About ten years ago, the supply of buckwheat products in industry was minimal, with the exception of traditional products in individual countries or social environments. Traditionally, buckwheat groats (thermally processed or raw – uncooked) and buckwheat flour are produced in several areas of the world. In Italy and in some Asian countries, some traditional types of pasta (Soba noodles, Pizzoccheri) are known, in France galettes pancakes, in Slovenia buckwheat bread and 'žganci'. Recently, many new and even innovative buckwheat products have appeared in the world. In addition to buckwheat groats and buckwheat flour, there is also buckwheat semolina and crumble on the market. Recent trends suggest the production of various buckwheat flours (wholemeal, white, dark buckwheat flour). A tricolor mix of porridge (a mixture of roasted buckwheat groats, red quinoa, and brown rice) of a Slovenian producer is appearing on the market for the preparation of risottos. Buckwheat groats are also used as an ingredient in several instant soups from various world manufacturers. Buckwheat polenta (from buckwheat semolina) and corn polenta with buckwheat (so-called black polenta) are on the market. Different types and shapes of dried and fresh buckwheat pasta are made, mostly with 30% buckwheat flour. They also make buckwheat gnocchi and ravioli. In Slovenia buckwheat 'štruklji' from common and Tartary buckwheat with cottage cheese or walnuts are produced. It is also very popular to add various additives to pasta, for example, spinach, nettles, tomatoes, dried red pepper powder, activated charcoal, flax seeds, sunflower seeds, cheese, spices, herbs, etc.). There is also Tartary buckwheat couscous on the market.

Different types of bread are produced from common and Tartary buckwheat (the proportion of buckwheat is 30%), buckwheat toast and buckwheat rusks. The use of common buckwheat predominates, but there are more and more products made of Tartary buckwheat. Large bakeries also decide for their production. One can find ready-made mixtures for making buckwheat breads. Mixtures for buckwheat pancakes are nowadays produced industrially and ready-made and frozen buckwheat pancakes. Fresh and frozen buckwheat products from puff

and leavened puff pastry (croissants, pads, burek) are becoming a regular offer in the Slovenian retail network. The products are often enriched with additives (spinach, minced meat, walnuts, chocolate, jam, fruit, etc.). There are also different types of buckwheat biscuits on the market (common buckwheat biscuits, hearts, stars, Linzer cookies, etc.). Buckwheat can also be an extruded product (wafers), often together with other cereals, e.g. rice, corn, as well as quinoa, chia seeds, etc. It can be added to a breakfast mixture of cereals, it can also be used as buckwheat corn flakes, buckwheat flakes, buckwheat popcorn and as a snack. Buckwheat is an ingredient in baby food from most major industrial manufacturers.

Buckwheat is also found in many non-dairy beverages, as a substitute for milk, or as buckwheat tea from flowers or groats, buckwheat iced tea or buckwheat ice tea with fruit flavors. Buckwheat beer has been on the market for several years, but in smaller industrial series. Buckwheat vodka, whiskey, and other alcoholic beverages and vinegar are also produced. Interesting products are also kombucha with buckwheat, ice cream with buckwheat groats or roasted buckwheat flour, and chocolate and chocolate pralines with buckwheat groats or flour. We also know the salty vegan buckwheat spread and the sweet buckwheat and chocolate spread. In some countries, buckwheat waffles and buckwheat beads (wafers) are also available. Energy drinks and snacks with the addition of buckwheat are also available for athletes and other active people. We also use buckwheat sprouts in the diet. Buckwheat is used as green buckwheat tea, and green leaf flour is also added to foods as a functional additive. Parts of fresh plants can be used as vegetables as they are rich in flavonoids (Kreft et al., 2006).

3 THE OFFER OF BUCKWHEAT DISHES IN GASTRONOMY

The offer of buckwheat dishes in gastronomy is becoming a hit. Buckwheat festivals, days of buckwheat delicacies, weeks of buckwheat cuisine, and competitions in preparing buckwheat dishes are organized from year to year. The winning menu at the Master Chef Slovenia in 2021 competition included buckwheat in the menu. The well-known Sunday supplement of the largest Slovenian newspaper Delo OK – Open Kitchen announced a competition for the best buckwheat dish. The media, magazines, newspapers, as well as online media, are devoting themselves to the new offer and often include buckwheat

dishes among their contents, to which caterers give a touch of culinary experiences. In addition to traditional buckwheat dishes, top-quality buckwheat cuisine and culinary artistry appear. From buckwheat dough they make „beds“, on which they put meat, vegetables (for example, 'roast on a buckwheat bed'), various leaves, flowers and other decorations to decorate the dish. Buckwheat snacks are in the appetizers in the multi-course menus. Buckwheat popcorn is offered in soups and raw meat, such as fish steak tartare, as a sprinkle on sweet and savory dishes and ice cream. Baked fish is prepared with buckwheat flour, as well as traditional dried meat 'Prekmurska šunka' (Prekmurje ham). Buckwheat is also available in the fast food offer. The menus include buckwheat pizzas, buckwheat pasta, risottos with buckwheat groats. Buckwheat is used in Slovenia to make French croissants and 'burek', which are two traditional dishes of other European cuisines, and part of the wheat flour has been replaced

by buckwheat flour. Homemade buckwheat pasta and gnocchi are becoming part of farm tourism offers. To this pasta herbs, pumpkins, chard, carrots, onions, fennel, parsley and everything suitable that grows on the farm are also added.

4 CHALLENGES

4.1 Gluten - free, sugar - free, lactose - free foods

Buckwheat is a gluten-free food, so it is also used to make gluten-free foods. The offer includes various gluten-free buckwheat mill products, gluten-free buckwheat breads and gluten-free buckwheat pasta. These products mostly have other gluten-free flours added, usually soy flour, soy starch, potato flour or rice flour. The development of technologies also enables us to make products from 100% buckwheat flour (common or Tartary), guar



Figure 2: Tartary buckwheat biscuits with stevia and pieces of chocolate (without white sugar)

flour, Indian plantain flour (*Psyllium*), eggs, etc. can be added. Gluten-free products can also include buckwheat groats, buckwheat flour and semolina, buckwheat corn flakes, buckwheat flakes, buckwheat popcorn, buckwheat couscous, buckwheat ‘žganci’ and buckwheat ‘polenta’, buckwheat waffles, some buckwheat non-dairy drinks, buckwheat teas and some iced tea drinks and buckwheat alcoholic drinks. However, in technological processes it is necessary to evaluate the presence of gluten in cereals such as barley, wheat, spelt, rye, as well as oats. The gluten-free food industry is primarily aimed at diagnosed patients with celiac disease, but more and more people are refusing to use wheat flour or even self-diagnosing themselves as gluten intolerant. The number of such consumers are increasing, and they represent a significant part of gluten-free food buyers.

Sugar-free buckwheat products are also on the market. They can be intended for diabetics if sugar is replaced with other sweeteners. However, it is not necessary, as some consumers are just looking for products without white sugar, even though they are not diabetics. White sugar (sucrose) in the diet in large quantities is not desirable, so there is a growing demand for products that do not contain white sugar. Other sweeteners (such as erythritol, birch sugar, maple syrup, stevia, etc.) are used instead of cane or beet sugar (sucrose). The production of such products requires newly developed technological procedures to produce confectionery, as other sweeteners behave completely differently in the preparation of the dough than sugar. By adding sugar substitutes, an attempt is made to achieve approximately the same sweetness, the energy value of sweeteners is lower, and the glycemic index of these sweeteners is also lower or even significantly lower. In combination with buckwheat or Tartary buckwheat, these sugar-free products still gain in nutritional value. Developing delicious sweets (cakes, rolls, biscuits), without the taste of sweeteners and with good other sensory properties (texture, color, smell, appearance) is becoming a challenge for manufacturers.

There is also a demand for lactose-free products on the market. It is estimated that around 5% of the population in Europe is lactose intolerant or has at least similar problems, so they use lactose-free products such as lactose-free milk or plant-based beverages (such as soy, rice, oat and buckwheat drinks). Yet there is still a low number lactose-free buckwheat products on the market.

Vegetarians and vegans could also be included among the seekers and potential buyers of such products.

4.2 Foods without additives, with healthy supplements, super foods

Consumers are becoming more demanding and behaving responsibly towards their health. That is why they also want to choose healthy foods. They are becoming skeptical about certain ingredients in foods, especially additives. They are increasingly motivated to educate or self-educate themselves about healthy eating through verified or unfortunately even unverified sources.

The offer of unleavened breads is being developed, either with the addition of baking powder, baking soda, Cream of Tartar or with the addition of mineral water. This challenge is also important for buckwheat producers.

More and more different buckwheat products will be on the market with added health-friendly ingredients such as antioxidants, vitamins, soluble fiber, bran, minerals, omega 3 fatty acids, and other supplements. This will further enrich their nutritional value. Due to its excellent nutritional composition, especially due to the high content of flavonoids (rutin), buckwheat could be considered a super food. Tartary buckwheat in particular could be added as a supplement to other food products.

The directions of our research are new technologies to produce buckwheat products without gluten and without sugar, and with high-value supplements (for example, the addition of grape seed flour, chia seeds, etc.). We are also determining an acceptable proportion of grape seed flour for technologically and sensory well-rated Tartary buckwheat breads, sponge cake, biscuits and pasta. Further research is ongoing.

5 CONCLUSION

The selection of buckwheat products and drinks has expanded. The market is dominated by common buckwheat, but the production of Tartary buckwheat products is on the rise. New varieties of Tartary buckwheat are being confirmed, and the technology of grinding and milling is being developed. On the market you can choose between raw and heat-treated buckwheat groats. There is not yet a great choice among buckwheat flours. The possibilities of making white and dark buckwheat flour and wholemeal buckwheat flour are indicated. Buckwheat bread is one of the most popular flour products, in addition to ‘žganci’ and buckwheat pasta. The offer of buckwheat soft drinks is increasing, and there is also a herbal buckwheat drink on the market as a ‘substitute’ for milk. Traditional and modern media (newspapers, newly published books, tel-



Figure 3: Tartary buckwheat cake with rhubarb, agave syrup, cream and strawberries (without white sugar).



Figure 4: Gluten free (100% buckwheat flour) common buckwheat sponge cake with added milled poppy seeds, and topped with sugar ornament.



Figure 5: Tartary buckwheat cake with added milled grape seeds (5%), and fresh grapes in the cream filling. (Tartary buckwheat flour and spelt flour 1:1).

evision shows, and online information) contribute to the growing popularity of buckwheat. Buckwheat is offered as a high-quality crop with an excellent nutritional composition, which customers increasingly recognize. Buckwheat is also interesting for diabetics, and as a gluten-free food for patients with celiac disease. To avoid white sugar, white flour and salt, buckwheat products without sugar, without white wheat flour, without lactose, without yeast, will be increasingly sought after. Buckwheat bread with less salt is an important market niche, as salt intake is too high in both the adult population and children. Buckwheat also contains antioxidants (especially rutin), which are friendly to health. Buckwheat is recognized as a suitable food for babies and children, athletes and heavy manual workers, and the elderly. Above all, it can be an important food source for an active population that cares about their health.



Figure 6: Gluten free buckwheat bread (100% common buckwheat flour).



Figure 7: Tartary buckwheat swiss role with raspberry filling (Erythritol is used instead of white sugar).

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7 REFERENCES

- Dietrych-Szostak D. 2004. Flavonoids in hulls of different varieties of buckwheat and their antioxidant activity. In: Advances in Buckwheat Research. Proceeding of the 9th Int. Symp. on Buckwheat, Praga, August 18-22. Praga, IBRA: 621–625
- Hatcher D. W., You S., Dexter J. E., Campbell C., Izydorczyk M. S. 2008. Evaluation of the performance of flours from cross- and self-pollinating Canadian common buckwheat (*Fagopyrum esculentum* Moench) cultivars in soba noodles. Food Chemistry, 107: 722–731. DOI 10.1016/j.foodchem.2007.08.072

- Ikeda S., Yamashita Y. 1994. Buckwheat as a dietary source of zinc, copper and manganese. *Fagopyrum*, 14: 29–34
- Kreft I., Fabjan N., Yasumoto K. 2006. Rutin content in buckwheat (*Fagopyrum esculentum* Moench) food materials and products. *Food Chemistry*, 98: 508–512. DOI 10.1016/j.foodchem.2005.05.081
- Steadman K. J., Burgoon M. S., Lewis B. A., Edwardson S. E. 2001. Buckwheat seed milling fractions: description, macronutrient composition, and dietary fibre. *Journal of Cereal Science*, 33: 271–278
- Škrabanja V., Kreft I. 1998. Resistant starch formation following autoclaving of buckwheat (*Fagopyrum esculentum* Moench) groats. An in vitro study. *Journal of Agricultural and Food Chemistry*, 46: 2020–2023
- Škrabanja V., Kreft I., Golob T., Modic M., Ikeda S., Ikeda K., Kreft S., Bonafaccia G., Knapp M., Kosmelj K. 2004. Nutrient content in buckwheat milling fractions. *Cereal Chemistry*, 81, 172–176.
<https://doi.org/10.1094/CCHEM.2004.81.2.172>
- Vombergar B. 2021. Rutin and quercetin in common and Tartary buckwheat flour and dough. *Fagopyrum* 38 (2): 43-53. DOI <https://doi.org/10.3986/fag0022>
- Vombergar B., Dolinšek J., Kreft I., Horvat M., Vorih S. 2020. Brez glutena/Gluten free. Ljubljana: Založba Kmečki glas, 136 pp.
- Vombergar B., Horvat M., Vorih S., Pem N. 2021. New trends in preparing buckwheat dishes in Slovenia. *Fagopyrum* 38 (2): 35-42. DOI <https://doi.org/10.3986/fag0021>
- Vombergar B., Horvat M., Vorih S., Pem N., Hostnik S., Kreft I., Germ M., Vogrinčič M. 2013. Opportunities in development of bakery and confectionery products from tartary buckwheat. In: Buckwheat (Ed. Vogrinčič, M. et al.). 12th Int. Symp. On Buckwheat, Laško Avgust 21-24, 2013.
- Vombergar B., Horvat M., Vorih S., Kreft I., Germ M., Pem N., Hostnik S., Berlič S., Kovač T. The use of Tartary buckwheat in gastronomy - development and trends. In: European Regional IBRA Meeting, 10th-12th December 2015, National Museum of Natural History Luxembourg. Ries, C. (ed.), Zewen, C. (ed.), Kreft, I. (ed.). *Euro Ibra 2015: Buckwheat in Europe: history, culture, gastronomy and nutrition: book of abstracts*. Luxembourg: National Museum of Natural History, 2015, 32.
- Vombergar B., Kreft I., Horvat M., Vorih S. 2018. Ajda/Buckwheat. 2. Dopolnjena izdaja. Ljubljana: Založba Kmečki glas, 136 pp.
- Vombergar B., Kreft I., Horvat M., Vorih S., Germ M., Tašner L., Vombergar N., Kovač T. 2016. Buckwheat in Food Culture of Slovenia. In Proceedings of the 13th International Symposium on Buckwheat (ISB), Cheongju, Korea, 9–11 September 2016.
- Vombergar B., Luthar Z. 2018. Raziskave vsebnosti flavonoidov, taninov in skupnih beljakovin v frakcijah zrn navadne ajde (*Fagopyrum esculentum* Moench) in tatarske ajde (*Fagopyrum tataricum* Gaertn.). *Folia biologica et geologica*. 59, 101-158. DOI <http://dx.doi.org/10.3986/fbg0047>
- Vombergar B., Škrabanja V., Germ M., 2020. Flavonoid concentration in milling fractions of Tartary and common buckwheat. *Fagopyrum*. 37, 11-21. DOI <https://doi.org/10.3986/fag0013>
- Vombergar B., Tašner L., Horvat M., Vorih S., Pem N., Golob S., Kovač T., Kreft I. 2021. Buckwheat - trends in nutrition and technology. 3rd European Buckwheat Symp., 14–15 September, 2021. Book of Abstracts (ed. D. Janovska), p.24.

IZVLEČEK

Ajda – izzivi v tehnologiji in prehrani

Na trgu prevladuje navadna ajda, narašča tudi pridelava in uporaba tatarske ajde. Potrjene so nove sorte tatarske ajde, razvija se tehnologija luščenja in mletja ajde. Za potrošnike postaja ponudba tatarske ajde dostopnejša. V industriji se močno razvija ponudba ajdovih izdelkov in pijač. Na trgu je veliko različnih ajdovih kruhov (delež ajde je večinoma do 30 %), tudi ajdov toast in ajdov prepečenec. Prevladuje uporaba navadne ajde, kruhov iz tatarske ajde je malo.

Ponudba ajdovih jedi v gastronomiji je vedno bolj opazna. Organizirajo se festivali ajde, dnevi ajdovih dobrot, tedni ajdove kulinarike, tekmovanja v pripravi ajdovih jedi. K vedno večji popularnosti ajde prispevajo tradicionalni in sodobni mediji. Med svoje vsebine uvrščajo ajdove jedi, ki jim gostinci dajejo pridih kulinarčnih doživetij. Priljubljeni postajajo

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ajdovi izdelki in jedi brez glutena, brez sladkorja in brez laktoze. Gluten-free, sugar-free, lactose-free products (including buckwheat) are becoming a food hit. Tudi ajdovi izdelki z manj soli so vključeni v ponudbe izdelkov in jedi za ohranjanje zdravja.

Ta članek je bil predstavljen na 3th EuroIbra, Prague, Czech Republic, septembra 2021, tu pa je prvič objavljen.