Impressum

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Table of contents

INTRODUCTION 5

TALK ABSTRACTS 7
- Buckwheat food factory of the future may offer products with inhibitory activity against formation of advanced glycation end-products 8
- Anticancer effect of in vitro digested buckwheat products \( (\text{Fagopyrum esculentum} \text{ Moench}) \) on HT-29 human colon cancer cell line 10
- Health-active Compounds in Buckwheat Products 12
- How common is buckwheat allergy in Sweden and China? 14
- Cultural and medical aspects of buckwheat in Sweden 16
- Buckwheat \( (\text{Fagopyrum esculentum} \text{ Moench}) \) low molecular weight seed proteins are restricted to the embryo and are not detectable in the endosperm 18
- Pollen attributable to \( \text{Fagopyrum} \) in western Eurasia prior to the late Medieval: an intercontinental mystery 20
- Connecting East and West: \( \text{Fagopyrum} \) as a proxy of plant cultivation and movement of peoples in Asia and Europe 22
- Buckwheat status in Denmark 24
- Buckwheat: its utilization in Japan and our buckwheat research 26
- Buckwheat at a forest-agriculture interface in Europe and Asia 28
- Presentation of Rangus Mill activities 30
- The Use of Tartary Buckwheat in Gastronomy – Development and Trends 32
- The Tartary Buckwheat Culinary Culture of the Nuosu Yi people of Liangshan (China) 34
- Moulds for shaping and decorating Tartary buckwheat foods 36
- The problems in cultivation of buckwheat in Poland 38
- Wet-milling of buckwheat with or without hull 40
- Prospects for growing and using Tartary buckwheat in Poland 42
- Spatial distribution of mineral elements in Tartary buckwheat grain, groats and sprouts 44
- The effect of sulphur and selenium on two species of buckwheat 46
- Farming practices and yield variation of buckwheat in Finland 48

POSTER ABSTRACTS 51
- The content of dietary fiber and polyphenols in buckwheat \( (\text{Fagopyrum tataricum}) \) depending on the morphological parts of the plant 52
- Common buckwheat in the Czech Republic 54
- Characteristics of phenolic compounds and minerals in buckwheat grains and groats 56
- The influence agronomic factors on flavonoid content in buckwheat seeds 58
- Buckwheat in old Polish literature (until the eighteenth century) 60
- Buckwheat research to diversify cropping systems – activities in Switzerland 62

LIST OF PARTICIPANTS 65
INTRODUCTION

Dear participant to euro-ibra 2015,

On behalf of the organising committee and all our sponsors, it is our great pleasure to welcome you to the first “euro-ibra” European Regional IBRA Meeting. For the first time, buckwheat researchers from all over Europe come together to present and discuss their research on History, Culture, Gastronomy and Nutrition. The European Regional IBRA Meeting brings together 35 scientists from 12 countries: Czech Republic, Denmark, Finland, France, Germany, Japan, Luxembourg, Poland, Slovenia, Sweden, Switzerland & United Kingdom. Details about all the participants can be found in the list of participants at the end of this book. We hope that this three day conference (10-12 December) will provide a forum to discuss current challenges in buckwheat research and focus the debate on future needs for the development of our knowledge on several aspects of buckwheat in Europe and Asia.

The origin of this European Regional IBRA Meeting in Luxembourg reaches way back to the mid 1990ies, when a farmer came up with the question of the conservation of Tartary buckwheat (*Fagopyrum tataricum*) as a crop for human consumption in the small hilly region “Éislek” - a part of the Ardennes extending across the borders of Luxembourg, Belgium and Germany. This resulted in the awareness that a special crop was about to disappear from the agricultural system, the gastronomical tradition and the culture of an entire region. After several publications (1) and a growing interest for buckwheat, a book project about buckwheat emerged, which rapidly extended its geographical focus from the Ardennes to the entire European continent. Together with the then young transnational organization “Islek ohne Grenzen EEIG” (2), a first edition (3) of “Das Buchweizenbuch” (“Book of Buckwheat”) was published in 1999, followed in 2007 by a revised and expanded edition (4). Since then the idea of organizing a meeting of scientists researching on buckwheat got persistent in the people involved and we are grateful that it was possible to realise this idea in 2015. During the preparation of this conference, we benefited from a wealth of contacts and gained many new insights.

Finally, we would like to thank all the organizations committed in this conference which are the National Museum of Natural History Luxembourg, the International Buckwheat Research Association IBRA, the Luxembourg Ministry of Agriculture, The Luxembourg Naturalist Society and the foundation “Fondation faune-flore”.

We wish you a good conference.

Luxembourg, November 27th 2015

Christian Ries, Christian Zewen & Ivan Kreft

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(2) Cf. www.islek.eu


TALK ABSTRACTS
Buckwheat food factory of the future may offer products with inhibitory activity against formation of advanced glycation end-products

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Key words: Fagopyrum esculentum, Fagopyrum tataricum, buckwheat bitter tea, buckwheat hull tea, buckwheat-enhanced wheat bread, rutin enriched rye-buckwheat cake, anti-glycation activity

The buckwheat food factory of the future is considered as waste-free and energy saving. The potential non-pharmacological prevention of buckwheat products from the buckwheat food factory of the future against formation of advanced glycation end products (AGEs) due to the presence of quercetin-3-O-rutinoside (rutin) – the main buckwheat flavonoid – was addressed in this study. AGEs are a complex group of compounds formed in a non-enzymatic pathway when reducing sugars react with amino acids of proteins and other molecules. Protein glycation in human is believed to be implicated in the development of chronic degenerative diseases.

In this study the inhibitory activity of ready-to-drink bitter buckwheat tea from raw tartary buckwheat groats, buckwheat hull tea originated from common buckwheat, traditional and novel innovative buckwheat enhanced wheat and rye bakery products against AGEs formation was studied in a bovine serum albumin (BSA)/glucose and BSA/methylglyoxal (MGO) systems whereas aminoquanidine (AG), a commonly used inhibitor of glycation process, has served as a reference compound.

In our study rutin was found as the main bitter buckwheat tea flavonoid while quercetin was not detected. The ready-to-drink bitter buckwheat tea showed 69% inhibition of the formation of AGEs whereas that noted for green tea with mint reached 98%. Regarding common buckwheat, rutin and vitexin were the main flavonoids found in buckwheat hull tea. The buckwheat hull tea showed lower inhibitory activity against the formation of AGEs as compared to green tea. The studies showed a high inhibitory effects of buckwheat enhanced wheat breads, formulated on dark wheat flour and flour from roasted buckwheat groats, against AGEs formation Moreover, the inhibitory effects of rye-buckwheat ginger cakes supplemented with low and high rutin dosages was evidenced. The results of the inhibitory activity were highly correlated in two applied model systems.

In conclusion, the bitter buckwheat tea and buckwheat hull tea may offer a potential therapeutic approach for diseases prevention when used as the main single tea ingredient or as a mixed component of other tisanes. The provided potent inhibition effect of buckwheat enhanced dark wheat breads and rutin enhanced rye-buckwheat ginger cakes against AGEs formation suggests their possible beneficial roles in the prevention of glycation-associated diseases. However, the characterization of flavonoids metabolites, metabolite biochemical effects, and metabolite structure-function relationships is still a key factor to better understanding of the role of these compounds in diseases prevention.

The participation in the conference was supported by the grant of KNOW Consortium “Healthy Animal – Safety Food” (MS&HE; Decision No. 05-1/KNOW2/2015).
Anticancer effect of in vitro digested buckwheat products (*Fagopyrum esculentum* Moench) on HT-29 human colon cancer cell line

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Key words: *Fagopyrum esculentum*, in vitro digestion, polyphenols, flavonoids, thiamine, amino acids

The most common form of cancer in affluent western countries is cancer of the colon and rectum. This type of disease now causes more deaths than any other. The incidence of cancer is much lower among vegetarians, those who consume no meat or dairy products. Scientific evidence has reported beneficial effects of bioactive compounds on human health, especially in protecting against chronic diseases, such as: cardiovascular diseases and cancer. Many authors have described that high consumption of fruit and vegetables decreases the risk of colorectal cancer. It is associated with their phenolic and flavonoid components, which are present in plant food.

Raw buckwheat grains (RG), roasted buckwheat grains (RSG), roasted buckwheat groats (BG), cooked roasted buckwheat groats (BGC), broken roasted buckwheat groats (BBG), buckwheat bran (BBI), buckwheat waste (BBII) and buckwheat hull (BH) were obtained from a commercial food company “Podlaskie Zaklady Zbozowe”, Bialystok, Poland. The content of flavonoids and phenolic acids were estimated using UHPLC method (Agilent Technologies 1200 series system chromatograph with SB-C18 column). Chromatograms were recorded at 280 nm for gallic acid, vanillic acid, p-hydroxybenzoic acid, and catechin, at 320 nm for rutin and quercetin. Amino Acid Analyser T 339 (Microtechna, Praha) was used for detection of exogenous amino acids: valine, methionine, isoleucine, leucine, phenylalanine, lysine, histidine, arginine, and endogenous amino acids: aspartic acid, serine, glutamic acid, proline, glycine, alanine, cysteine, tyrosine. The content of thiamine in buckwheat products was estimated by using thiochromic method (Jenway 6200 fluorometer). The MTT test was used for estimate of cancer cell metabolic activity.

The aim of this study was estimated of effect of some selected bioactive substances on cytotoxicity of HT-29 cancer cell line. Negatively significant correlation between growing of HT 29 cell line and catechin (-0.53), serine (-0.49), proline (-0.54), glycine (-0.61), histidine (-0.62) and arginine (-0.42) was observed. Using multidimensional approach, can be established that the higher concentration of individual amino acids and polyphenolic compounds in the samples caused higher inhibition of HT 29 cancer cell line growth. The most effective action demonstrated buckwheat bran and buckwheat waste, which were clearly separated from the other samples.
Health-active Compounds in Buckwheat Products

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Key words: Fagopyrum esculentum, F. tataricum, Secondary compounds, flavonoids, anthraquinones, naphthodianthrones, fagopyrin, rutin

Buckwheat, Fagopyrum esculentum MOENCH and F. tataricum (L.) GAERTN. grain has been used as a cereal crop for thousands of years, particularly on poor soils. However, it has been neglected since intensive agriculture had been capable to even make poor soils volatile enough by applying mineral fertilizers, so that farmers preferred to grow crops with far higher yields such as the grains from the grass family: wheat, rye, barley, corn et cetera. In recent years it started its renaissance as a cereal free of gluten for the diet of people suffering from coeliac disease and sprue.

Buckwheat grain proteins contain a high quantity of lysine and few glutamic acid and proline; additionally they have higher concentrations of aspartic acid and arginine than other cereal proteins. They also have an intense supplemental effect with other proteins to improve the dietary amino acid balance to stimulate biological activities such as cholesterol-lowering effects, but even supporting anti-hypertension. They are used against constipation, to treat obesity conditions in a comparable manner as dietary fiber (Dziedzic et al 2012). Aside from its proteins, buckwheat is also rich in components with healing effects on chronic diseases. Among others these are flavones, flavonols (Liu et al 2008), D-chiro-Inositol, and myo-inositol (Koyama et al 2013). Furthermore, buckwheat shows hypolipidemic effects (Tomotake et al 2014).

When used to prepare teas the grain undergo several steps including soaking, steaming, additional drying; removal of hulls and finally roasting leading to a different composition of ingredients (Qin et al 2013).

Buckwheat leaves are a relatively new medicinal remedy. The flavonol rutin (syn. Rutosid), present between 3 - 10 % in the dried leaf, is mainly responsible for or its pharmaceutical use as varicosis treatment (Schilcher et al 2010).

In both, grain and leaves, further secondary compounds are known which have pharmacological as well as toxicological meaning; among those laxative anthraquinones, e. g. emodines, as well as phototoxic naphthodianthrones such as Fagopyrin and derivatives must be mentioned (Benkovic et al 2014).

References
How common is buckwheat allergy in Sweden and China?

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Key words: Fagopyrum esculentum, F. tataricum, food allergy, Sweden, China, students, coeliac disease

Introduction: Buckwheat allergy is an IgE mediated food allergy sometimes causing severe reactions (1). In Sweden, the consumption of buckwheat is rare except among patients with gluten intolerance (coeliac disease). In Shanxi province in China, consumption of common buckwheat (Fagopyrum esculentum) and tartary buckwheat (Fagopyrum tartaricum) is common while in other parts of China, e.g. in Shanghai, the consumption is low. The aim was to investigate self-reported buckwheat allergy in mid-Sweden and in two areas in China (Shanxi and Shanghai).

Material and methods: In Sweden, students and school personnel from 48 randomly selected schools were investigated in 1993-1994. Moreover adults in Stockholm belonging to a society for patients with coeliac disease were investigated in 2005. Data from seven prevalence studies (in 2002-2009) among students from Shanxi and two prevalence studies among students in Shanghai (in 2000-2009) were included. Standardised questionnaires were distributed with questions on food allergy/intolerance, including buckwheat allergy.

Results: In the Sweden 2239 adults and 2410 students participated. (80-85% response rate) and 11% of the adults and 8% of the students reported any food allergy/intolerance. None of the adults or the students reported buckwheat allergy. Totally 870 adults (73%) from the Swedish society for patients with coeliac disease participated. In total, 69% consumed buckwheat and 34 subjects reported buckwheat allergy (3.9%). The most common problems when eating buckwheat were gastrointestinal symptoms (23 subjects), one person reported skin symptoms, one headache and one breathing difficulties. Totally 10192 students from Shanxi participated (90% response rate) and 7.5-10.4% reported any type of food allergy/intolerance. The prevalence of self-reported buckwheat allergy was 0.4% (41 cases). The most common reaction when eating buckwheat was gastrointestinal symptoms, few reported asthma when eating buckwheat. The majority got symptoms within 15 minutes after eating buckwheat. None reported any anaphylactic shock from buckwheat. Totally 3348 students from Shanghai participated (90% response rate). Totally 5.5-7.5% reported any type of food allergy/intolerance but none reported buckwheat allergy.

Conclusions: In groups with low consumption of buckwheat in Sweden and China none reported buckwheat allergy. In Shanxi province where buckwheat consumption is high, 0.4% reported buckwheat allergy. Most patients in Sweden with coeliac disease consumed buckwheat and 3.9% reported buckwheat allergy. The most common reaction was gastrointestinal symptoms, few reported asthmatic symptoms and none reported anaphylactic shock when eating buckwheat.

Cultural and medical aspects of buckwheat in Sweden

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Key words: Sweden, history, *Fagopyrum esculentum*, *Fagopyrum tataricum*, health

The landscape in Molkom in western part of Sweden has changed. In 2015 you find the largest cultivation of buckwheat, both *Fagopyrum esculentum* (Moench) and *Fagopyrum tataricum* (Gaertner) in Sweden, totally 175 hectares around the old farm Råglanda. The Swedish botanist Carl von Linne (1707-1777) reported on buckwheat cultivation in 1749 on sandy slopes in Scandia, an area in south Sweden and described the beautiful buckwheat flowers and how they attracts bees. He writes that “Porridge from buckwheat was well boiled, consumed and accompanied by beer drinking by peasants in the evenings”. Tartary “bitter” buckwheat might be healthier, but was rarely consumed. Carl von Linne organized a botanical garden in Uppsala. Today, common and tartary buckwheat are still grown in this garden. The climate is suitable for buckwheat in southern and middle Sweden.

Buckwheat came to Sweden from Asia in the 15-16th century but in the 19th century buckwheat disappeared and was replaced by wheat and other cereals with bigger yield. Buckwheat was initially consumed as porridge and later as blini, müsli, sour bread, buns, cakes, biscuits and recently Japanese soba have been introduced. Buckwheat does not contain gluten and is often consumed by those with gluten intolerance (celiac disease). In 2013 EU supported a small project in Scandia and introduced soba making at a Food festival 2014. Today, Värmland is the main buckwheat area in Sweden, The Swedish couple Anders and Birgitta Nilsson started buckwheat cultivation in 2006, a revival of buckwheat in Sweden after 150 years. They have six subcontractors and totally 175 hectares of buckwheat and a yield of 80 ton of buckwheat 2014, both common and tartary buckwheat. After 60-70 days of cultivation it is harvested, dehusked, rinsed, grinded and packed. The farmer Anders Nilsson has developed his own machinery for dehusking and sieving.

In 1980 I started my research on buckwheat allergy. One patient in Stockholm had developed buckwheat allergy with eyes and nose symptoms and breathlessness. She was a young immigrant packing imported buckwheat for a major Health Food Company. We found that almost half of the workers at the company had antibodies in their blood to buckwheat (verified buckwheat allergy). After our investigation, the company moved their packing of buckwheat products to New York. Later my research has been focusing on the beneficial health effects of antioxidants in buckwheat. Studies have demonstrated that it can lower cholesterol and lower blood pressure and may lower the risk for diabetes, cardiovascular diseases, colon cancer and Alzheimer. The new Swedish policy to grow more sustainable crops and the increased market for functional ecological food grown locally will hopefully increase the market for common and tartary buckwheat in Sweden.
Buckwheat (*Fagopyrum esculentum* Moench) low molecular weight seed proteins are restricted to the embryo and are not detectable in the endosperm

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Key words: Allergenic proteins, Endosperm, *Fagopyrum esculentum*, Low molecular seed proteins, SDS-PAGE electrophoresis

Buckwheat (*Fagopyrum esculentum* Moench) proteins are nutritionally important because of their high and balanced content of essential amino acids making their biological value much higher than that of cereal proteins. Allergy to buckwheat is typically IgE mediated and it is often associated to severe anaphylaxis.

We analyzed extracts of buckwheat endosperm and embryo proteins by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). On electropherograms of endosperm proteins, six intense bands were detected. Two most intense bands were in the range of molecular weights (M.W.s) from 50 to 60 kDa. Protein of 57 kDa has been shown not to cross-react against antibodies raised against proteins of M.W. ranging between 23 and 25 kDa. There are no reports about the allergenicity of other endosperm proteins. On the electropherogram of buckwheat endosperm no low M.W. proteins could be detected.

In this study we have demonstrated the tissue specific presence of proteins of different size classes of the endosperm and embryo tissues.
Pollen attributable to *Fagopyrum* in western Eurasia prior to the late Medieval: an intercontinental mystery

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Key words: Palynology, Pollen, Vegetation History, Western Eurasia

The widespread perception that buckwheat did not occur in Europe prior to the Late Medieval is challenged by numerous pollen finds. We traced 170 records from western Eurasia with the pollen occurs in often much earlier time-slices. The clear pollenmorphological characteristics make a large-scale misidentification unlikely. Except for some clear cases, the majority of the finds does not show indication of contamination. If all the observations are unreliable, it implies a major careless work-style in many palynological laboratories. We assume that many finds have never been reported under “it cannot be, thus it should not be”: we know of several scientists who deliberately concealed their finds for fear of ridicule.

Cultivation of *Fagopyrum* started in eastern Tibet around 6000 cal yr BP. Genetic studies demonstrate that the European populations descend from populations in northern China, and that plants migrated westward along the trade routes commonly known as Silk Streets. Already 4000 years ago trade had proceeded to a level that continuous exchange of goods between China and the Mediterranean took place. Theoretically, buckwheat cultivation in Europe may, thus, have started in the Bronze Age.

From the area of the Ukraine, Scythians have been reported to have grown buckwheat since the early Iron Age, and exported cereals to the ancient Greek world. It is possible that *Fagopyrum* was introduced in Europe from Scythia, but did not gain sufficient popularity for large-scale cultivation. However, the finds from Scythian archaeological monuments are highly ambiguous and the role of this society in the distribution of buckwheat remains unclear.

Only for the Early and High Medieval there is sufficient evidence for the conclusion that buckwheat was widely cultivated in Europe, i.e. 800-900 years earlier than generally assumed. Large-scale cultivation, however, only started after the Medieval.

It is possible that the finds result from long-distance transport of pollen of *Oxygonum* or *Harpagocarpus snowdenii / Fagopyrum snowdenii* from the African continent. However, we inspected the African Pollen Database and found that pollen attributable to these taxa has only been found incidentally. If these pollen types hardly occur in the African pollen rain, a major transport to Europe seems unlikely.

Pollen grains have also been found in Weichselian deposits in west Eurasia. Ecologically, wild *Fagopyrum* species may very well have occurred in the steppe vegetation. The example of the African *F. snowdenii* proves that not all species of the genus remained restricted to the southern Chinese realm, but that at least one taxon has migrated westward across the entire Asian continent (unless it was dispersed by migrating birds). We postulate, therefore, that a wild *Fagopyrum* species may have occurred widespread in Eurasia prior to the Holocene. However, we have no hard evidence for this.
Connecting East and West: *Fagopyrum* as a proxy of plant cultivation and movement of peoples in Asia and Europe

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Key words: *Fagopyrum*, Spread of buckwheat, Asia, Europe

Understanding the spread of buckwheat (*Fagopyrum* spp) is one of the most interesting problems in the interpretation of the origins of agriculture in Europe and Asia. It is a plant that allows us for the first time to look at different centres of plant cultivation going beyond the seminal work of Vavilov in 1926 and subsequent publications of a number of archaeobotanists (e.g. Harris 1996, Harris & Hillman 1989, Zeist et al 1991, Zohary & Hopf 1993). I proposed establishing a new centre in Northwestern India, Kashmir, Afghanistan and Nepal (Janik 1998) and in this presentation I present evidence that this centre has also influenced the adoption of agriculture in East Asia. By looking at buckwheat’s climatic preferences we can easily understand its adaptational qualities in traveling east towards northeastern China and Japan, and towards the west as far as Denmark, Latvia and Finland. By following the appearance of buckwheat in the context of pollen diagrams and carbonised remains, we can establish the spread of plants originating from outside well-established centres of plant cultivation. In China, as in Europe, buckwheat has been linked with the cultivation of domesticated cereals (wheat - *Triticum* and barley – *Hordeum*). One of the sites in China is located on the route today known as the Silk Road, predating the historical routes by c 5000 years. This is very interesting in letting us use *Fagopyrum* as a proxy in establishing routes and connections prior to the silk trade.

What is unique to *Fagopyrum* is its role as a plant companion of domestic cereals in this period of agricultural practices, rather than as a particular source of plant cultivation and consumption. In the earliest periods of its appearance in Europe and China, the presence of buckwheat complements the appearance of domesticated grasses like wheat and barley, and weeds that are indicators of the domesticated plants’ cultivation. Buckwheat pollen generally preserves well while the seeds do not, which produces a bias in the evidence towards pollen rather than seed remains. One of the most interesting details we can use in analysing plant pollen is information related to the way beverages were flavoured by past communities. The pollen found in a residue inside a drinking vessel suggests that the beverage was sweetened by mead, and one of the plants from which the bees collected the nectar was buckwheat. While we can argue that pollen of other plants could be brought by the wind from long distances, the pollen grain of *Fagopyrum* is large and heavy, not allowing its transportation further than 2 km, which in turn provides us with the local indicator of its occurrence and human agency in sowing the plant. This is significant for archaeologists since in correlating dates we see the presence of the plants as part of the composition of the plant assemblage seeded and reseeded from year to year. The single species crop is a modern development, and the use of ‘clean’ seeds’ containing only one type of plant such as barley or wheat and the use herbicides In the past the harvested plants were mixed, some being cereals and others companion plants, which in today’s vocabulary would be categorised as weeds. I argue that buckwheat was one of those plants. The seeds were consumed together giving flavour and unique qualities to the food consumed and drunk in the past, and forgotten today.
Buckwheat status in Denmark

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Key words: Fagopyrum esculentum, Denmark, history, gastronomy, agronomy.

Buckwheat (Fagopyrum esculentum), originating from China, was introduced to Europe in the Middle Age, and it has been grown in Denmark since year 1500. It was produced on light soils of the island of Fyn, and South and West Jutland. It had same importance as rye, but after 1815 it was replaced partly by the potato, introduced from the south. Buckwheat was consumed mainly as porridge and beer.

Hans Christian Andersen wrote a fairy tale in 1842, called “The buckwheat”, about arrogance and decay:

..in the surrounding fields, not only rye and barley, but oats,—pretty oats that, when ripe, look like a number of little golden canary-birds sitting on a bough. The cereals have a smiling look and the heaviest and richest ears bend their heads low as if in pious humility. Once there was also a field of buckwheat, and this field was exactly opposite to the old willow-tree. The buckwheat did not bend like the cereals, but erected its head proudly and stiffly on the stem. “I am as valuable as any other crop,” said he, “and I am much handsomer; my flowers are as beautiful as the bloom of the apple blossom, and it is a pleasure to look at us. Do you know of anything prettier than we are, you old willow-tree?”

When a heavy storm passed, all the crops survived by bending their heads, whereas the buckwheat died for being arrogant.

Learning from experience, buckwheat is back! It is characterized with a short growing season of just 10 to 12 weeks, even under North European conditions, after which the dark brown, triangular seeds ripen. It has a high content of the amino acid lysine, and contains high levels of calcium, iron, potassium, magnesium, silicon and fluorine. Buckwheat is glutenfree but some people are allergic to the dye fagopyrin contained in buckwheat outer shell, which is usually removed. Buckwheat is established in May, with small amounts of manure and without weed control.

Buckwheat is entirely dependent on pollination by bees. It is a good bee plant, because of its long flowering time and its high content of nectar. Flowering begins 5-6 weeks after sowing. Buckwheat can provide up to 400 kg/ha of a very strong honey.

Buckwheat can either be harvested directly on the root or swathed. Swathing is a good method since buckwheat because of its long flowering period matures unevenly. Swathing should be done when 75% of the seeds are hard and brown.

The average yield level in Denmark is about 1t/ha, although higher yields have been obtained. New cultivars have been tested, with good properties for food use.
Buckwheat: its utilization in Japan and our buckwheat research

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Key words: *Fagopyrum esculentum*, *Fagopyrum tartaricum*, Japan, nutrition, palatability

Noodles made from buckwheat flour-water dough are popular in Japan. In Japan, buckwheat noodles are a popular, traditional food. Traditional buckwheat noodles preparation methods have long been reported in Japanese history for about four hundred years or more. In particular, traditional buckwheat noodle-preparation methods have been developed in Edo, whose name is the former one for Tokyo (the capital of Japan). Although excellent techniques, if any, might lie behind, the scientific basis involved in such excellent techniques remains largely uncertain. Clarifying such excellent techniques in buckwheat noodle-preparation methods is a subject of great interest in view of sensitivity science. In this connection, the mechanical characteristics of buckwheat foods may be an important quality attribute affecting their palatability and acceptability. There are two types of cultivated buckwheat species, i.e., common buckwheat (*Fagopyrum esculentum* Moench) and Tartary buckwheat (*F. tataricum* Gaertner). A major difference between the two species, is that common buckwheat is utilized worldwide, whereas Tartary buckwheat is utilized as a traditional food in relatively-limited regions such as the south region of China, Bhutan, the region of the Himalayan hills from northern Pakistan to eastern Tibet, and in Islek in Europe (Kreft, Ries and Zewen, 2007). Recent studies have suggested that Tartary buckwheat may exhibit beneficial effects on human health (Lin, 2013). Thus a large amount of attention has been currently paid to Tartary buckwheat and the development of new products made from Tartary buckwheat is currently the subject of great interest.

We have tried to clarify some characterization of common and Tartary buckwheat in view of nutrition and palatability with acceptability including traditional preparation technique and new development. Our analysis has shown some mechanical characteristics of buckwheat (Ikeda et al., 2004 and 2005) and a difference in mechanical characteristics between buckwheat and other cereals (Asami et al., 2006). In addition, our analysis has shown a difference in mechanical characteristics between common buckwheat and Tartary buckwheat (Ikeda et al., 2003; Asami et al., 2007). Furthermore, we have shown some scientific basis involved in excellent techniques of Japanese traditional buckwheat noodle-preparation (Asami and Ikeda 2005; Asami et al. 2009). On the other hand, we have shown some characteristics of buckwheat components, especially resistant components (K. Ikeda et al., in press). There are many unanswered questions concerning buckwheat. Our research data may hopefully stimulate further investigation to fully answer them.
Buckwheat at a forest-agriculture interface in Europe and Asia

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Key words: Fagopyrum, history, environment, sustainability

In Bhutan, Japan, China and Korea, buckwheat is used mostly to prepare noodles and other pasta products. In Italy, buckwheat flour is used to prepare typical pasta. In Austria and Slovenia traditional dishes such as kasha and bread are made (Vombergar et al., 2014). In Asia (Japan, Korea, China, Nepal) buckwheat is cultivated in high altitudes, sometimes above 3000 m. In Japan, buckwheat is cultivated at least since the year 722 (A.D.), and it is spread in various areas, including mountain areas (Ikeda K. and Ikeda S., 2003). Humans used fire as an effective management tool to transform the evergreen forests into secondary vegetation, such as buckwheat cultivation (Shu et al., 2013). According to C. Zewen (pers. comm.) in Germany and Luxemburg buckwheat was grown in oak tan-bark coppice after cutting. Buckwheat fields are often mixed with areas covered by forest. Such systems are traditional in Northern Italy, Slovenia, Bosnia and Herzegovina, China, Bhutan, Korea and Japan. Forest trees give to buckwheat fields protection from strong winds and are a shelter for propagation of pollinators. In Japan, the abundance of the important pollinator wild bee Apis cerana in the buckwheat fields shows a stronger positive correlation with the total area of surrounding natural forests compared to that of surrounding plantation forests (Taki et al., 2011). Buckwheat fields are not only a nectar source for wild insects but as well a food source for birds and wild animals, thus supporting the maintaining species and genetic diversity. It is important to notice that no spraying with pesticides is needed in buckwheat production, so buckwheat is a source of »organic« food for people and wildlife.

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References


Presentation of Rangus Mill activities

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Key words: Fagopyrum esculentum, Fagopyrum tartaricum, mill, products

Consumers are demanding more and more natural and healthy foods. Rangus Mill produces organic and conventional products and has developed in 2015 a new line of gluten-free products.

It is a traditional mill with milling stones, based on a hundred years tradition and ownership by Rangus family. Quality and durability of quartz-based milling stones for milling flour are very well known. Its products are very popular among bakers and consumers.

Rangus Mill is located in the village Dolenje Vrhpolje - which is a part of the local community Šentjernej in Dolenjska region of Slovenia - and is known for:
- high quality milling products, based especially on common (Fagopyrum esculentum) and Tartary buckwheat (Fagopyrum tartaricum), spelt wheat (Triticum spelta) and other special cereal products;
- buckwheat and other groats;
- ecological buckwheat pillows;
- fish farming, based on a local creek Kobila.
The Use of Tartary Buckwheat in Gastronomy – Development and Trends

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Key words: Fagopyrum tataricum, bread, confectionery, gluten-free products, new technologies, gastronomy

In the Slovenian cuisine there can be fund a variety of traditional dishes made of common buckwheat (Fagopyrum esculentum) as buckwheat” žganci”, buckwheat groats, ”štruklji”, a buckwheat pocket, buckwheat bread. For making bread and cakes it is used a mixture of buckwheat and wheat flour in order to achieve better rheological properties of dough, because buckwheat contains no gluten. Tartary buckwheat (Fagopyrum tataricum) is less known, although it was grown in Slovenia in the past, but in the last fifty years it has been almost forgotten.

At the Education Centre Piramida Maribor we have developed more than 100 different products and dishes from Tartary buckwheat. The product development was carried out in cooperation with Slovenian Tartary buckwheat producer and miller Anton Ragus. We observed and studied the characteristics of the different sort of dough from the Tartary buckwheat flour and a mixture of Tartary buckwheat and wheat flour and developed several technological processes in production of bread, cakes and pasta. Technologically suitable are mixtures of 30-50% of Tartary buckwheat, although possible is also a higher part of it. Equal proportions of flour mixtures were used in the confectionery industry for the production of puff pastry (for rolls, cream cakes, etc.) and leavened sweet milk dough for “potica”(nut-roll). Preparation of buckwheat pasta is simple when using a mixture of Tartary buckwheat and wheat flour in the ratio of 1:1.

The demand for gluten-free products is increasing. We investigated which products from 100% Tartary buckwheat flour have good organoleptic properties. These are products of brittle and honey dough (various buckwheat biscuits, gingerbread), but we can also make Tartary buckwheat biscuits and pies as gluten-free products. Much more difficult it is to use Tartary buckwheat as the only flour for bread and other products made of leavened dough. Technologies in this way have been explored and we have searched for appropriate solutions. Another product is also Tartary buckwheat groats which can be served with vegetables as a side dish. Cooked groats can be served as a dessert with yogurt and fruit or we can add it to ice-cream. Cooked groats may be additionally baked in the oven by adding cottage cheese, sour cream, eggs, sugar and fat. We are also developing chocolate pralines with Tartary buckwheat groats. Another possibility is also Tatary buckwheat mush or ”polenta” made of flour of buckwheat and corn semolina. In Slovenia we also produce traditional sausages with buckwheat groats, where Tartary buckwheat can be also used. These are all gluten-free products.

For Tartary buckwheat it is typical a slightly bitter taste, which may be distracting to the consumer. In preparation procedures one can partially overcome it by the addition of additives (e.g. spices, herbs, etc.), but the best way is to get used to it and become completely fond of Tartary buckwheat.
The Tartary Buckwheat Culinary Culture of the Nuosu Yi people of Liangshan (China)

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Key words: Fagopyrum tataricum, China, Yi, Nuosu

This paper examines the culture of Tartary buckwheat or bitter buckwheat (Fagopyrum tataricum) - among the Nuosu of China from the vantage point of traditional and contemporary modes of preparation and consumption. The Nuosu are a sub-branch of the so-called Yi ethnic minority, which spreads over the southwestern Chinese provinces of Sichuan, Yunnan, Guizhou, and Guangxi.

The Nuosu of the Greater and Lesser Liangshan mountains on the border between Sichuan and Yunnan Provinces have cultivated Tartary buckwheat, called mge in the Nuosu language, for centuries. Tartary buckwheat continues to be a major staple food for Nuosu of both rural and (semi-) urban areas in Liangshan today. Bbabba, or cooked breads, and a variety of buckwheat-based dishes are commonly served to accompany soup and meat in rural settings.

One of the major celebrations, the so-called Torch Festival (dutzie), features buckwheat offerings to the ancestors in the shape of animals and everyday objects. During the Yi New Year in November home-brewed alcohol is traditionally made from mge, among other ingredients, and is served to family and guests. These are only some examples that highlight the integral functions that Tartary buckwheat continues to serve in Nuosu quotidian life, and especially in rural settings of Liangshan.

Over the past twenty years the commercial repertoire of bitter buckwheat production in Liangshan Yi Autonomous Prefecture has been expanded to accommodate yet more and new modes of preparation, which cater primarily to Han Chinese consumers and are paving the way to new and possibly sustainable modes of consumption (recipes, gastronomy) and production for bitter buckwheat in the area.
Moulds for shaping and decorating Tartary buckwheat foods

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Key words: *Fagopyrum tataricum*, baking mould

The purpose of this communication is to show the possibilities offered by buckwheat for preparing shaped and decorated foods with pastry moulds. We would like to provide the participants of this symposium with ideas and suggestions about several types of savoury and sweet recipes. We would also like to give buckwheat consumers the opportunity to make these pastries themselves in order to avoid unwished ingredients possibly present in commercial pastry and make tasty buckwheat foods look good.

The custom of decorating pastry with pictures and symbols was practiced in many cultures around the world. In the beginning, it was food for the gods. Food is life. Our ancestors thought that gods also need food. First, they offered blood sacrifice but at the onset of agriculture appeared a novel bloodless offering, a flat cake made from cereal dough kneaded with honey. Due to its outstanding plasticity similar to clay, it was used to shape cakes bearing legible messages for the deity. Later, moulds have been used to decorate food for all feasts of the year or as a honor gift. In some regions of Europe and Asia, this tradition is still alive. Only experience, right recipes, skills and expertly carved pastry moulds can guarantee baking success and prevent this cultic pastry to be forgotten.

Nuosu Yi people from Liangshan in Sichuan province of Southwestern China shape animal figures from Tartary buckwheat dough for wedding feasts or the Fire festival. Tartary buckwheat was also a staple food in some European mountain regions until the end of the nineteenth century - for example in the Islek region covering the northern part of Luxembourg and the cross-border region with Germany and Belgium, where it is still grown today as a relict crop on about 20 ha. Around 1995, farmer Paul Pletgen told C. Zewen that gingerbread can be made with Tartary buckwheat. This information motivated gingerbread specialist Dr. Almute Grohmann-Sinz from Berlin (www.modelbacken.de) to explore the feasibility of making moulded pastries with buckwheat. The first trials in 2014 already showed that the gluten-free buckwheat dough has excellent, almost unique plasticity properties whereas standard wheat doughs mixed with eggs, honey or syrup have a tendency to expand in the oven and distort the imprint on the top. But buckwheat dough is not suited for the “Spekulatius” technique.
The problems in cultivation of buckwheat in Poland

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Key words: Fagopyrum, agrotechnic factors, winter rye-catch crop, weed infestation, yield

In Poland buckwheat is cultivated on 70 thousand ha. Broader interest in cultivation of the species is limited by low level and large variability of yields in the years.

In this presentation we will evaluate the influence of specific agrotechnological factors on the yield of buckwheat crops.

Additionally, based on own studies, we will show the effect of winter rye as a catch crop on buckwheat, the rye’s biomass being incorporated into the soil by plough or rototiller. The effect of rye biomass on yielding of two buckwheat cultivars will be presented.

Moreover we will present the weed suppressing effect of the rye catch crop, buckwheat crops being sensible to weeds particularly in the early stages of vegetation, even if it is characterized for it’s relatively great competitiveness towards weeds.
Wet-milling of buckwheat with or without hull

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Key words: Fagopyrum, wet-milling, hull, starch, protein

Wet-milling is a process involving physical, chemical, biochemical and mechanical operations to separate the principal components from different types of grains. This process consists basically of two steps: soaking in water solutions of alkali or acid at a given temperature, followed by mechanical separation that takes advantage of the differences in the physical properties (density and particle size) of the fractions: starch, protein, germ, fibre and hull. This study was undertaken to determine the recovery of each component of buckwheat with or without hull by wet-milling and the analysis of obtained fractions: starch and proteins.

For the laboratory wet-milling buckwheat with hull and dehulled were steeped in solution with SO2 and lactic acid at 28°C for 16 h and 2 h, respectively. Starchy materials obtained was characterized by determining starch extraction efficiency, particle size distribution and microstructure. The pasting (RVA) and thermal properties (DSC) were also analyzed. The proteins fraction was characterized by determining functional properties and SDS-PAGE profiles. The starch extraction efficiency was higher for total starch isolated from buckwheat with hull compared to dehulled. The mean particle diameter of the pure starch isolated from both buckwheat was about 18 µm. The longer time of steeping of buckwheat with hull caused the decrease in temperature of gelatinization compared to the dehulled ones. Significantly higher enthalpy values for both pure starches compared to the other samples were noticed. The increasing of gelatinisation enthalpy with increasing of the steeping time and the higher proteins amount was observed. The image of electrophoretic separation did not show changes between the two protein fractions obtained during wet-milling of both types of buckwheat. The water absorption index for both protein fraction was almost the same. Whereas, the water solubility index for protein isolated from dehulled buckwheat was higher compared to protein fraction obtained from buckwheat with hull. In the case of oil absorption capacity it was about two-times higher for protein isolated from buckwheat with hull compared to protein isolated from dehulled buckwheat.

Generally it can be concluded that the wet-milling method used did not affect significantly on the properties of the obtained starch and proteins in comparison with starting material. Wet-milling of buckwheat can be used as an effective method for dehulling of buckwheat, without changes of the quality parameters of isolated fractions.

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Prospects for growing and using Tartary buckwheat in Poland

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Key words: Fagopyrum tataricum, production, utilization, nutritional value, cultivar diversity, breeding, acclimatization

After common buckwheat, Tartary buckwheat (Fagopyrum tataricum Gaertn.) is the second most popular domesticated species of the genus Fagopyrum. Its cultivation area is limited to several Asian countries, mainly China, Tibet, Nepal and India. Some small plantations of Tartary buckwheat in Europe can be found in certain regions of Austria, Slovenia, Germany or the Benelux countries. In Poland, Tartary buckwheat is not considered to be a commercial crop, but it grows as a weed in fields of common buckwheat, especially in poor soil. A growing interest in Tartary buckwheat is stimulated by its nutritional value and therapeutic properties. Tartary buckwheat contains several active nutrients, whose health-promoting properties have been proven. An example is rutin, which accumulates in grains rather than in hulls of Tartary buckwheat, unlike in common buckwheat.

The purpose of our study has been to evaluate the yield and quality of achenes of Tartary buckwheat growing in Poland. A controlled, two-factor field experiment was conducted in 2010-2015. It was located on two completely different soil stands (fertile and poor soil). The two factors consisted of five genotypes of Tartary buckwheat and two nitrogen fertilization levels (0 and 40 kg ha⁻¹). Three genotypes represented commercial cultivars originating from China while two other genotypes were wild forms growing as weeds in plantations of common buckwheat near Lublin and Olsztyn. The following were assessed: plant emergence, morphological traits of plants and yields of harvested achenes. The determinations included the weight of 1,000 achenes, percentage of hulls in total weight of grains and basic chemical composition of grains. In addition, an assessment of the selected traits was made on the five tested genotypes and two other forms of Tartary buckwheat originating from Lithuania and Slovenia, which are grown in a plant collection field of the UWM Chair of Plant Breeding and Seed Production, maintained at an experimental garden. The genotypes were observed to be highly varied in terms of the plant’s external shape, height and biomass gain. An undesirable feature detected during our study was the variability in flowering induction, which resulted in fruit development occurring over a long period of time within the same genotype. The yield of achenes was typically small and variable in years, mostly due to the intensive shedding of fruits.

The 1,000 grains weight was more strongly varied by the weather conditions than by a genotype. Tartary buckwheat achenes were characterized by a large share of the hull in total weight, usually exceeding 35%.

In Poland, a principal obstacle to the promotion of cultivation of Tartary buckwheat is the lack of cultivars adapted to local conditions (photoperiod), resistant to grain shedding and characterized by desirable processing characteristics (easy dehulling). Another problem is an inadequate development of Tartary buckwheat processing technologies.
Spatial distribution of mineral elements in Tartary buckwheat grain, groats and sprouts

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Key words: Fagopyrum tataricum, mineral-element distribution; nutritional value; micro-imaging

In Slovenia two buckwheat species can be purchased commercially, common buckwheat (Fagopyrum esculentum Moench) and Tartary buckwheat (Fagopyrum tataricum Gaertn.). Both are predominantly consumed as groats and flour and traditionally prepared in various dishes.

Grains are processed hydrothermally to ease the removal of inedible husks yielding groats or are milled into flour. Recently, sprouts of buckwheat species have been introduced as functional vegetable (Kim et al. 2004).

Knowledge on spatial distribution of mineral elements within grains, groats and sprouts can significantly contribute to the improvement of the quality of grain and groat milling fractions and to the understanding of mineral element partitioning during sprouting, so as to provide desirable final mineral element concentrations in view of the need to alleviate micronutrient malnutrition in humans (Stein 2010). Routinely this knowledge is being obtained through studying grain and groat milling fractions (e.g. Steadman et al. 2001), which involves mechanical and/or chemical destruction of the tissues leading to unintentional mixing of the tissues. Using micro-imaging tools that avoid these destructive procedures we determined spatial distribution of Mg, P, S, K, Ca, Mn, Fe, Cu and Zn in Tartary buckwheat grain, groats and sprouts.

In the grain, the highest concentrations of all of the studied mineral elements were in the cotyledons, except Ca, which dominated in the husk (Pongrac et al. 2013). Similar was the spatial distribution of mineral elements in the groats, except Ca, whose concentration was diminished through husk removal (Pongrac et al. unpublished).

In sprouts higher concentrations of mineral elements were seen than in grains and groats with several re-localisation events in the cotyledons, mainly affecting Ca distribution (Pongrac et al. unpublished).

Routine and reliable analyses of mineral element distributions can contribute significantly to answering basic questions in plant physiology and to improve quality of the grain and groat milling fractions. Owing to the increased public interest in alternative functional and gluten-free foodstuffs, popularisation of both buckwheat species is anticipated to lead to increasing demand for products of this crop within Slovenia as well as Europe.
The effect of sulphur and selenium on two species of buckwheat

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Key words: Fagopyrum tataricum, Common buckwheat, selenium, sulphur, yield

Two species of buckwheat, Tartary buckwheat (Fagopyrum tataricum) and common buckwheat (Fagopyrum exculentum) were foliarly sprayed with Se and S to study the possible synergistic effect of both elements on Se accumulation. Plants of both species were cultivated on the field in natural conditions. The highest concentration of Se was measured in leaves and seeds followed by roots and husks. Concentration of Se did not differ significantly between control and S treated plants in both species. Interestingly, in Tartary buckwheat the concentration of Se was higher in S+Se treated plants compared to only Se treated plants in the roots, leaves, seeds and husks. That suggested that S positively affected Se uptake in Tartary buckwheat.

Majority of measured morphological characteristics as well as yield in both species were similar in control, S, Se and Se+S treated plants. Results showed that it is possible to produce grain and herb of Tartary and common buckwheat with appropriate amounts of Se for health benefit in human nutrition without affecting morphological characteristics and yield of buckwheat treated with Se and S.

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Farming practices and yield variation of buckwheat in Finland

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Key words: Fagopyrum, flowering, soil moisture, sowing technology, daily average temperature, yield

Yield variation of buckwheat is well known problem decreasing the competitiveness of production and farmer’s interest to choose the crop as part of their cropping systems. Through the field experiments carried out at standardized conditions, several aspects have shown to affect to the yield formation of buckwheat. The improvement of varieties by plant breeding is one of the most important challenges. Since there is a lack of new buckwheat varieties suitable for northern growing conditions, other possible factors for yield improvements must surveyed.

To produce information, how buckwheat is actually cultivated and produced in practice, and the possible problems which may have got too little attention by researches, a farm survey was coordinated by Luke (former MTT – Agrifood Research Finland). The information from the buckwheat farming practices were gathered, samples from the soils and biomass of the fields taken and the weather parameters collected. The farming practice, which caused the biggest variation to the yields, was the sowing technology. Fields with direct sowing produced the highest yields compared to conventional sowing practices with ploughing. There are many possibilities to cause the differences in yields between the two technologies. Among the potential factors, soil conditions may have been the most important ones. The direct sowed fields were able to sustain moisture for the growth of buckwheat longer compared with the conventional systems, especially in the dry conditions in soils with high organic content in the year 2010. Another new factor, which may have caused yield variation, was the high daily average temperature during the flowering period.

Although the survey was restricted to consider only ten different fields in the central part of Finland, we were able to get information on the questions, which should study more deeply in the future. Surprisingly, the daily average temperature may rise sometimes too high for optimal seed production of buckwheat even in the growing conditions of the North Europe. It is also recommended, that the research culture of special crops should be developed towards a comprehensive process, where the information of the production technologies and field conditions in the practice, should be able to use as well.
POSTER ABSTRACTS
The content of dietary fiber and polyphenols in buckwheat (*Fagopyrum tataricum*) depending on the morphological parts of the plant

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Key words: *Fagopyrum tataricum*, polyphenols, dietary fiber, morphological parts

Buckwheat is widely used in Polish cuisine. Two buckwheat species are grown in Poland: common buckwheat (*Fagopyrum esculentum*) and a lot less frequent Tartary buckwheat (*Fagopyrum tataricum*). Only common buckwheat has an industrial significance, while Tartary buckwheat is mainly used as a green fodder. Buckwheat products are a source of biologically active substances, such as polyphenols, vitamins, amino acids, dietary fibre, and phytosterols.

The aim of this study was to determine the content of some bioactive substances of buckwheat (*Fagopyrum tataricum*) in roots, leaves, flowers, stems. The tartary buckwheat was obtain from Breeding Station Palikije (Poland). The content of neutral detergent dietary fiber (NDF) and its fraction: cellulose (C), hemicellulose (H) and lignin (L) were assayed by using Van Soesta method, and content of polyphenols were determined using LC-MS method described by Midlner-Szkudlarz et al., 2015. A total of 20 compounds has been detected, ie. 2,6-dihydroxybenzoic acid, 3,4-dihydroxybenzoic acid, 3,5-dihydroxybenzoic acid, caffeic acid, catechin, chlorogenic acid, fagopyrma, ferulic acid, gallic acid, isovanilic acid, isovitexin, kaempferol, luteolin, p-coumaric acid, procyanidin B2, quercetin, quercetin 3-D galactoside, rutin, syringic acid and vitexin.

The analyzed morphological parts of buckwheat plants were characterized by differing contents of dietary fiber expressed as NDF. Dietary fiber content was higher in the root (64%) compared with stem (37.4%), flowers (20.9%) and leaves (12%). The dominant fraction in all analyzed parts of buckwheat was the cellulose fraction. Moreover, leaves and flowers contained more lignin, but stem and root hemicellulose fractions. The individual anatomical parts were characterized by a varied polyphenol content. Among the polyphenols most abundant occurred rutin. The leaves contained significantly more rutin (2949 µg/1 g of sample) compared with the root and stem, respectively 1693 and 1255 µg/1 g of sample. They contained also more 3,5-Dihydroxybenzoic acid and caffeic acid. The flowers contained more 3,4-dihydroxybenzoic acid, chlorogenic acid, fagopirin, isovitexin, kaempferol and procyanidin.
Common buckwheat in the Czech Republic

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Key words: Fagopyrum esculentum, Czech Republic

Common buckwheat (Fagopyrum esculentum) belongs to the group so-called minor crops in the Czech Republic.

Although it was historically grown and was popular in low fertile or mountainous region, its use was diminished and during the centuries almost forgotten.

The renaissance of buckwheat use has started at the beginning of the 90’ of the last century.

Nowadays, it is much sought-after for its relatively modest growing conditions as well as for its nutritional composition.

Common buckwheat is one of the main cash crops under organic farming systems in the Czech Republic.
Characteristics of phenolic compounds and minerals in buckwheat grains and groats

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Key words: Fagopyrum, phenolics, mineral elements (magnesium, manganese, zinc, copper), groats

Buckwheat grain and buckwheat grain products are a rich source of protein with a well-balanced amino-acid composition, starch and dietary fibre, essential minerals and trace elements. This crop also contains antioxidant compounds which are responsible for beneficial health effects. There is some evidence that regular consumption of buckwheat products may reduce the risk of many diseases and play important role in human nutrition. The content of health promoting compounds depends on the kind of grain processing.

The objective of this study was to determine whether the health benefits of buckwheat grains, related with phenolics and some minerals content, change during the groats production. These components were analyzed in buckwheat grains and groats derived from three Polish mills.

Total phenolics were determined spectrophotometrically using extraction five times with 80% methanol at the temperature of 220°C with shaking, the addition of Folin-Ciocalteau reagent and sodium carbonate and then measurement of the absorbance at a wavelength of 720 nm against the reference sample. Concentrations of magnesium (Mg), manganese (Mn), zinc (Zn) and copper (Cu) were determined by flame atomic absorption spectrometry using UNICAM 939 SOLAR apparatus equipped with an OPTIMUS data station and background correction (deuterium lamp. Prior to determining the total contents of these essential minerals, the samples of buckwheat products were wet-ashed in a mixture of nitric and perchloric acids (3:1; Suprapure, Merck, Germany) on an aluminium electric heating block fitted with a programmable temperature setting, increasing the temperature gradually to 200°C.

It was showed that technological operations influenced on analyzed components in different degree. The process of roasting caused a threefold decrease of total phenolic content and some reduction of magnesium amount, influenced the increase of zinc and copper content, which may suggest that these components are especially sensitive to thermal treatment. Roasting didn’t influence on the manganese level but its content changed under dehulling process. Removing the husk resulted in reduction of manganese and copper content and caused an increase in amount of magnesium and zinc, which may indicate, that they are sensitive to mechanical processing.

Conclusions: The process of seed treatment affected in different ways on phenolic compounds and minerals. The process of roasting the greatest impact on reducing of phenolic compounds, while removing the husk resulted in reduction of manganese almost in half.

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The influence agronomic factors on flavonoid content in buckwheat seeds

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Key words: *Fagopyrum*, cultivars, flavonoids, rutin, agronomic factors

Buckwheat grains and hull consist of a number of components with healing properties and biological activity, i.e.: flavonoids and flavons, phenolic acids. Flavonoids consist of six compounds such as rutin, quercine, orientin, vitexin, isovitexin, and isoorientin. Rutin is the main flavonoid occurring in buckwheat. The content of flavonoids is mostly influenced by weather conditions during the growing period, as well as by cultivar, and cultivation technology. The rutin content, increases in long-day conditions, probably due to a higher UV-B radiation. In the dehulled nuts of the Polish cultivars, the rutin content oscillated between 9,0 (Kora cv) and 19,5 mg/100g (Emka, Panda)

In Polish conditions, the two experiments on the influence of sowing term and nitrogen fertilization on buckwheat flavonoids content was conducted on microplots of the Experimental station in Pulawy, Poland. In the first experiment three sowing term 1- at the beginning of May, 2-at the beginning of June, 3- at the beginning of July and two cultivars were experimental factors. In second experiment the factor was: nitrogen fertilization – control (without nitrogen apply); 30 kg N ha-1, 60 kg N ha -1. It was found that sowing term has a significant influence on rutin content in buckwheat nuts and hulls as well. A higher concentration in hulls was found when the buckwheat was sown in the beginning of July compared with beginning in May. In contrast the amount of rutin in dehulled seeds decreases with delayed of sowing term. Also the nitrogen fertilization on the level of 60 kg N ha -1 lead to the decrease in rutin and other flavonoids content in hulls. But the dose of nitrogen at 30 kg N ha -1 and 60 kg N ha -1 did not change significantly the content of rutin in dehulled nuts.
Buckwheat in old Polish literature (until the eighteenth century)

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Key words: Fagopyrum esculentum, Fagopyrum tataricum, tatarka, bread, edible plant, flour, fodder plant, green manure, groat, gryka, Kluk, melliferous plant, Syrennius (Syreniusz)

In Poland, common buckwheat or buckwheat (Fagopyrum esculentum Moench) is an edible species of plant which is still cultivated in the 21st century. The buckwheat planted in Poland is generally F. esculentum, while Tartary buckwheat (F. tataricum (L.) Gaertn.) is mentioned by contemporary authors as a weed and only rarely cultivated (e.g. Nowinski 1970, Podbielkowski 2003).

There is some misunderstanding in the Polish names of F. esculentum because the same plant is commonly called ‘gryka’ (the scientific Polish name for common buckwheat) and ‘tatarka’ (scientific Polish name for Tartary buckwheat). The Polish names ‘tatarka’, ‘tartarczane krupy’ [‘Tartar groats’] first appeared in the mediaeval manuscripts (chiefly in the fifteenth century) (Rostafinski 1900). The names ‘tatarka’ and ‘Ocimum Tragi’ were given by Schneeberger (1557) in a printed catalogue of Krakow plants referring to Fagopyrum esculentum. The same species was listed by Siennik in his herbal from 1568 under the names ‘tatarka’, ‘Frumentum Saracenicum, and ‘Heydenkorn’.

Extensive information can be found in the opus magnum of the Polish Renaissance – Zielnik [The Herbal ] by Syrennius (Syreniusz) (1613). It contains many bits of information on cultivation and use of F. esculentum for which the author provides the Polish names ‘tatarka’, ‘poganka’, as well as several Latin and German names. He writes that people eat it in the form of groats - coarse for farm servants, and very fine (‘as little pearls’) for the tables of nobility and royalty. Flour was obtained from it, used for baking bread when there were food shortages, and for preparing gruel for babies. He writes that in the old times, buckwheat (perhaps it referred to F. tataricum) was sowed as a fodder plant for stock animals.

Information on the cultivation of buckwheat (F. esculentum) was also contained in works on agriculture (Zawacki 1616, and Haur 1689), horticulture (Bernhard 1652), as well as in the physiographic description of Poland by Gabriel Rzaczynski (1721). In the eighteenth century, the use of buckwheat groats as food continued, and buckwheat flour mixed with wheat flour was used to make bread (Kluk 1787). Other applications included its use as a green manure, and as a melliferous plant.

Kluk also described Tartary buckwheat but only on the basis of publications and remarked that it was cultivated in Siberia and Sweden. Other data on buckwheat is provided by researchers of flora in present-day Belarus and Lithuania which were then parts of Poland. Information about the widespread cultivation of common buckwheat was also given by Jundzill (1791) in his description of Lithuanian flora. Gilibert (1792) described a new species F. sagittatum (presently a synonym of F. esculentum) as a cultivated plant. As a separate piece of information, he also referred to F. tataricum as probably an alien plant, which grew in large numbers in neglected fields.
Buckwheat research to diversify cropping systems – activities in Switzerland

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Key words: *Fagopyrum esculentum*, grain quality, phenotyping, genotyping, variety testing

Buckwheat (*Fagopyrum esculentum*) is a traditionally grown crop in Switzerland. After the Second World War, buckwheat was mainly replaced by arable crops with stable yield and a standardized agronomic management (Miedaner and Longin, 2012) and the cultivation area declined to a few hectares. Nevertheless, the beneficial aspects of buckwheat cultivation like diversifying the landscape, widening crop rotations and being an excellent bee crop as well as the gluten free and healthy grain composition motivated ETH Zurich and Agroscope to intensify research on this valuable crop (Stamp et al, 2012).

At ETH, 20 different buckwheat accessions were phenotypically described and grain quality was analysed by measuring content of protein, starch and anthocyanins and antioxidant activity. Here, special attention was devoted to the exploration of the intra- and inter-specific variability of the measured traits. In combination with a sequencing-based genetic characterisation, the phenotypic data will help to evaluate the potential of the accessions for breeding purposes and for large-scale cultivation.

Agroscope focuses on the production of buckwheat in terms of evaluating the best agricultural practice and establishing access to interesting varieties for Swiss farmers. Therefore, twelve out of the 20 buckwheat accessions originating from Austria, France, Russia and Slovenia are tested in field trials under organic and conventional farming systems. Investigated traits are soil cover, plant length, yield components and harvest modalities as well as stability. Another crucial aspect is the seed quality of the accessions, which is addressed in quality screenings and degustation in cooperation with ETH.

Together, the projects of Agroscope and ETH aim to contribute to an increase in buckwheat cultivation resulting in a higher diversity in the current food production system and an enhanced consumption of the healthy crop. For financial support our thanks to WFSC Coop Research Program, Foundation sur la Croix (FSC) and Bio Suisse and for excellent collaboration to HAFL, Biofarm and Mühle Rytz as well as to the breeders for providing the seeds.

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