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Front page photo: Bongpyoung, Korea: a view on the city, famous for flowering buckwheat and a buckwheat festival, see paper of C. H. Park and M.O. Park, pages 53-58.

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Research Paper

Antigenotoxic Effects of Tartary and Common Buckwheat Extracts, Rutin, and Quercetin on DNA Damage Induced by the Dietary Mutagen Acrylamide

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ABSTRACT

The antigenotoxic effects of methanolic extracts of Tartary (*Fagopyrum tataricum* Gaertn.) and common buckwheat (*Fagopyrum esculentum* Moench) flour were evaluated against acrylamide-induced DNA damage. Acrylamide, a toxic food contaminant, was first identified in 2002 following its detection in Swedish food products. Our findings demonstrate that extracts from both buckwheat species significantly reduced DNA strand breaks. Tartary buckwheat contains higher levels of rutin, quercetin, and polyphenols, and exhibits greater antioxidant activity compared to common buckwheat. Due to endogenous rutin-degrading glucosidase activity, part of the rutin was enzymatically converted into quercetin. Processing generally decreased antioxidant activity, with the exception of wheat bread, where a slight increase was observed, likely attributed to Maillard reaction products.

We confirmed that acrylamide induces genotoxic effects in HepG2 cells at all tested concentrations (0.3125, 0.625, 1.25, and 2.5 mM) after 24 hours of exposure, and that methanolic buckwheat extracts effectively reduced the formation of acrylamide-induced DNA damage. The extract from Tartary buckwheat demonstrated the highest antigenotoxic activity, surpassing even pure rutin or quercetin at higher concentrations. These results suggest that although thermal processing can generate potentially harmful compounds, such as acrylamide, food matrices may simultaneously contain bioactive components capable of counteracting or mitigating such adverse effects.

INTRODUCTION

Acrylamide is a chemical compound typically formed in starchy foods subjected to hightemperature processing such as baking, frying, and roasting. It is generally absent in foods that are boiled or prepared using microwave heating (Capuano & Fogliano, 2011). It forms as a byproduct of the Maillard reaction, occurring between naturally present carbohydrates and amino acids. While some Maillard reaction products exhibit beneficial antioxidant, antimicrobial, or anti-allergenic properties (van Boekel et al., 2010), others, especially those formed during thermal processing, can have mutagenic, carcinogenic, or cytotoxic effects (Knize et al., 1999). These include heterocyclic amines, nitrosamines, polycyclic aromatic hydrocarbons, 5hydroxymethylfurfural, and acrylamide.

Acrylamide is considered one of the most important heat-induced food contaminants. It has been detected in a wide range of food products, including potato chips, French fries, cornflakes, bread, cookies, and coffee, as well as in roasted nuts, olives, and—unexpectedly—dried fruits (Capuano & Fogliano, 2011; Lupăescu & Oroian, 2025). Numerous studies have confirmed its neurotoxic, mutagenic, and carcinogenic properties (Shipp et al., 2006, Govindaraju et al., 2024; Đekić et al., 2025).

Growing consumer interest in healthy eating, has revived attention toward traditional crops. Tartary buckwheat (*Fagopyrum tataricum* Gaertn.) and common buckwheat (*Fagopyrum esculentum* Moench) are two such underutilized crops, recognized for their high nutritional value and potential healthpromoting properties. In Europe, buckwheat is cultivated in several countries, including Russia, Belarus, Ukraine, Poland, Croatia, Slovenia, Austria, Denmark, and France, among other countries (Kreft, 1995; Jha et al., 2024).

Buckwheat is known for its excellent nutritional profile, particularly its richness in polyphenols, notably the flavonoids rutin and quercetin (Fabjan et al., 2003; Kreft et al., 2020). The aim of this study was to evaluate the potential antigenotoxic effects of methanolic extracts from buckwheat-based food products (bread, cookies) containing rutin and quercetin, against acrylamideinduced DNA damage in HepG2 cells *in vitro*.

MATERIALS AND METHODS

Initially, we assessed DNA damage in HepG2 cells induced by acrylamide at concentrations ranging from 0.3125 mM to 2.5 mM. Subsequently, we evaluated

whether cotreatment with methanolic extracts of common and Tartary buckwheat in the presence of 2.5 mM acrylamide, after 24-hour incubation could reduce DNA damage. A methanolic extract from wheat, which lacks rutin and quercetin, was included as a control.

Tartary buckwheat, common buckwheat and wheat flour extracts

Tartary buckwheat (TB) and common buckwheat (CB) were cultivated in the experimental field of the Biotechnical Faculty, University of Ljubljana, Slovenia, sown in June and harvested in August. Seeds were air-dried at 30°C until constant weight and milled using a Hawos Billy Mill 200 (Getreidemühlen Reisinger, Ybbsitz, Austria) to obtain TB and CB flour with a particle size of <0.236 mm. Commercial wheat (W) flour (type 850) was purchased from Mlinotest (Ajdovščina, Slovenia) and had flour particle size <0.200 mm. All flour samples are stored at University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia. Wheat was selected as a control material due to its compositional similarity to buckwheat but with negligible or non-detectable flavonoid content and markedly lower antioxidant capacity compared to buckwheat. This allowed exclusion of possible matrix effects when comparing the biological activities of flavonoid-rich material.

Methanolic extracts were prepared by adding 25 mL of 80% methanol (HPLC grade) in water to 1 g of each flour sample. The mixtures were shaken at room temperature for 8 hours at 250 rpm. Extracts were then filtered through filter paper (70 g/m², Macherey-Nagel, Germany), aliquoted, and stored at -20°C until further use.

Genotoxicity testing

The potential genotoxicity of wheat (W), common buckwheat (CB) and Tartary buckwheat (TB) extracts, as well as pure rutin (R) and quercetin (Q), was evaluated using the comet assay. HepG2 cells were seeded into 12-well microtiter plates (Corning Costar Corporation, Corning, NY, USA) at a density of 40,000 cells/well. After 24 h of incubation at 37°C in 5% CO₂ and humidified atmosphere, the growth medium (William's E) was replaced with a fresh medium, containing W, CB and TB extracts (0.04 %, 0.2 % and 1 % (v/v)), rutin (4, 20 and 100 µM) or quercetin (2, 10 and 50 µM). Cells were then incubated for an additional 4 and 24 hours under the same conditions. A negative control (non-treated cells),

a solvent control (1 % methanol in growth medium) and a positive control (benzo[a]pyrene [BaP], 30 μ M) were included in each experiment. At the end of the exposure (4 and 24 h), cells were harvested, and DNA damage was determined using the comet assay as described by Moller et al (2020). with minor modifications.

Comet assay

The comet assay was performed as described by Møller et al. (2020). Briefly, 30 μ L of cell suspension was mixed with 70 μ L of 1% low melting point agarose and immediately added to fully frosted microscope slides precoated with a layer of 1% normal melting point agarose. Cells were then lysed (2.5 M NaOH, 0.1 EDTA, 0.01 M Tris and 1% Triton X-100, adjusted to pH 10) for 1 h at 4°C. Afterwards, the slides were rinsed with distilled water, placed in electrophoresis buffer (1 mM EDTA, 300 mM NaOH, pH 13) for 20 min to allow DNA unwinding, and then electrophoresed for 20 min at 25 V and 300 mA. Subsequently, the slides were neutralized with 0.4 M Tris buffer (pH 7.5), stained with ethidium bromide (5 μ g/mL), and images captured using a fluorescence microscope (Nikon Eclipse 800). Images of 50 randomly selected nuclei per slide were analyzed using Comet Assay IV software (Perceptive Instruments, UK). The percentage of tail DNA was used as the measure of DNA damage. Three independent experiments were performed for each treatment condition.

Statistical evaluation

The comet assay results, differences between treatment groups within each experiment were analyzed using non-parametric analysis of variance (Kruskal-Wallis test). Dunnett's multiple comparison test was used for the evaluation of differences between solvent control (1% methanol) and sample groups; *P < 0.05; **P < 0.01; ***P < 0.001 was considered statistically significant.

RESULTS AND DISCUSSION

Our results confirmed that acrylamide, at concentrations between 0.625 and 2.5 mM, induced DNA strand breaks in HepG2 cells after 24 hours of exposure. For antigenotoxicity assessment, we selected 2.5 mM acrylamide, the concentration that exhibited the most pronounced genotoxic effect (Figure 1). These findings align

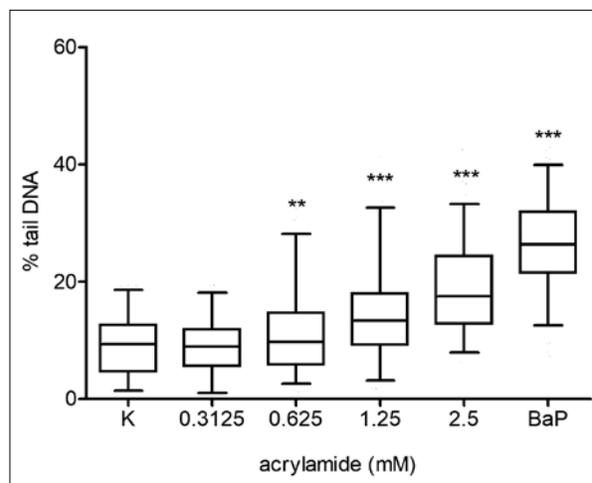


Figure 1. Effect of acrylamide at graded concentrations (0.3125, 0.625, 1.25, and 2.5 mM) on the formation of DNA strand breaks in HepG2 cells following 24 h exposure. Benzo[a]pyrene (BaP, 30 μ M) was used as a positive control for genotoxicity. DNA damage was assessed with the comet assay and is expressed as percent of tail DNA. Fifty cells were analysed per experimental point in each of the three independent experiments. Data are presented as quantile box plots. The edges of the box represent the 25th and 75th percentiles, the median is a solid line through the box, and the error bars represent 95% confidence intervals. Significant difference (1-way ANOVA; Dunnett's Multiple Comparison test) between treated cells and vehicle control (K) is indicated by **P < 0.01 and ***P < 0.001.

with previous studies documenting acrylamide's genotoxicity in hepatic cell lines, confirming its potential risk as a food contaminant (Shipp et al., 2006).

As shown in Figure 2, the methanolic extract from Tartary buckwheat provided the most effective protection against acrylamide-induced DNA damage, significantly reducing DNA strand breaks even at the lowest tested concentration (0.008 % (v/v)). This was followed by the extracts from common buckwheat, while the wheat extract demonstrated the weakest protective capacity. The superior antigenotoxic activity of Tartary buckwheat may be attributed to its higher polyphenolic content, particularly rutin and quercetin, known for their antioxidant and DNA-protective properties. The weaker effect of wheat extract supports the idea that flavonoid content plays a critical role in modulating genotoxic effects.

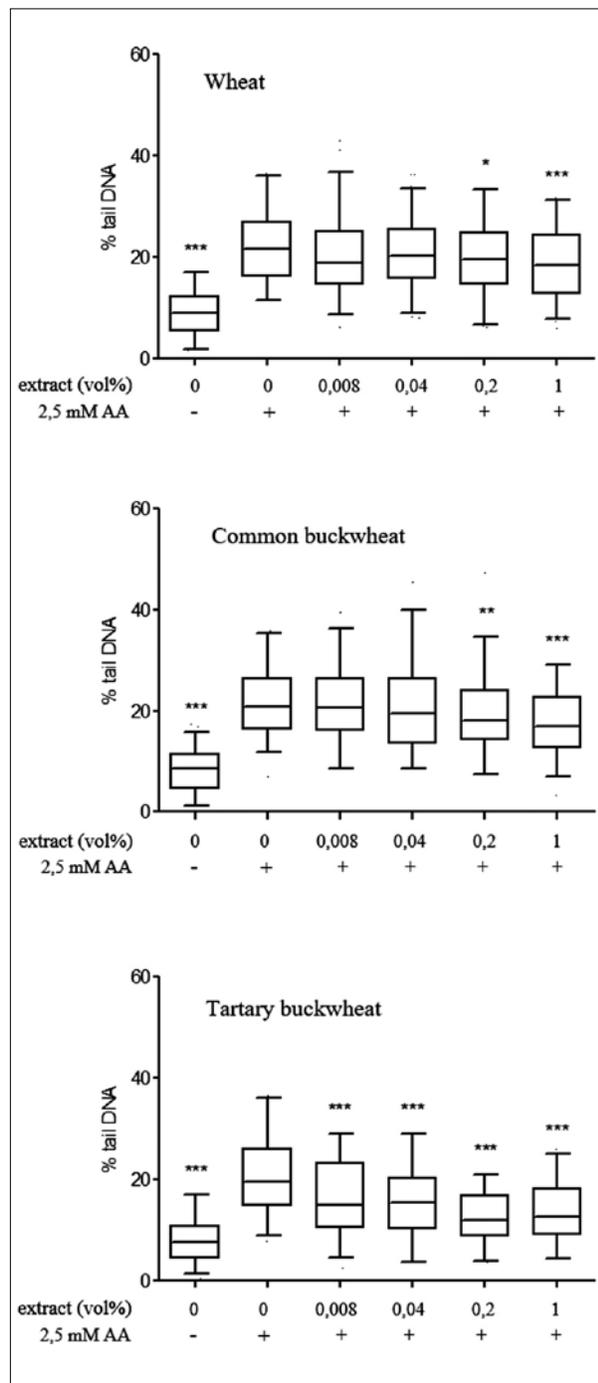


Figure 2. Antigenotoxic effects of methanolic extracts from wheat, common buckwheat, and Tartary buckwheat in HepG2 cells. DNA damage was induced by acrylamide (AA, 2.5 mM). DNA damage was assessed with the comet assay and is expressed as percent of tail DNA. Fifty cells were analysed per experimental point in each of the three independent experiments. Data are presented as quantile box plots. The edges of the box represent the 25th and 75th percentiles, the median is a solid line through the box, and the error bars represent 95% confidence intervals. Significant difference (1-way ANOVA; Dunnet's Multiple Comparison test) between treated cells and vehicle control (0 extract, - 2.5 mM AA) is indicated by **P < 0.01 and ***P < 0.001. (see legend below Figure 1).

When comparing the antigenotoxic potential of pure rutin (100 μ M) and quercetin (50 μ M), both flavonoids significantly reduced acrylamide-induced DNA damage in HepG2 cells (Figure 3). Notably, the protective effect of the buckwheat extracts was comparable to or even greater than that of the pure flavonoids, despite the lower concentrations of rutin and quercetin in the extracts. This suggests that additional compounds within the extracts may contribute synergistically to the observed DNA protection. Such synergy has been reported in complex plant matrices, where minor phenolics, vitamins, and other bioactive molecules enhance the overall antioxidant capacity (Alexander et al., 2023). It was suggested that a

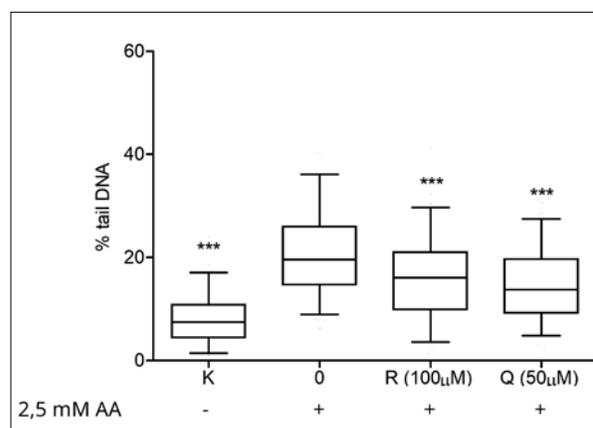


Figure 3. Antigenotoxic effects of rutin (R) and quercetin (Q) in HepG2 cells. DNA damage was induced by acrylamide (AA; 2.5 mM). DNA damage was assessed with the comet assay and is expressed as percent of tail DNA. Fifty cells were analysed per experimental point in each of the three independent experiments. Data are presented as quantile box plots. The edges of the box represent the 25th and 75th percentiles, the median is a solid line through the box, and the error bars represent 95% confidence intervals. Significant difference (1-way ANOVA; Dunnet's Multiple Comparison test) between treated cells and vehicle control (K) is indicated by **P < 0.01 and ***P < 0.001.

polyherbal kaempferol and quercetin-rich cocktail could treat Alzheimer's Disease related brain damage. In this way a mixture of natural flavonoids with synergistic effects could be supporting an alternative treatment to currently available medicines (Alexander et al., 2023). It was pointed out by Rahmatkar et al. (2024) that oxidative stress and neuroinflammation play a crucial role in neurodegenerative conditions. Based on the ethnomedical claims and available literature Rahmatkar et al. (2024) suggested that neuroprotective efficacy of a Tartary buckwheat seed extract could have effects against acrylamide induced neurotoxicity. Further investigations are needed to identify the specific compound(s) responsible for the observed antigenotoxic activity and to elucidate their mechanisms of action.

These findings are encouraging, as they demonstrate that bioactive compounds naturally present in foods — such as those in buckwheat — can counteract the harmful effects of substances formed during food processing, thereby mitigating or neutralizing their impact.

CONCLUSION

Our study confirmed the genotoxic potential of acrylamide in HepG2 cells at all tested concentrations after 24-hour exposure, reinforcing concerns about the health risks posed by this common food contaminant. Importantly, methanolic extracts from buckwheat significantly reduced acrylamide-induced DNA damage, with Tartary buckwheat extract exhibiting the strongest

antigenotoxic activity — even greater than that of pure rutin or quercetin. Such pronounced activity points to the presence of multiple bioactive components in Tartary buckwheat that synergistically enhance protection at the cellular level.

These findings highlight the promising role of naturally occurring compounds in foods as effective dietary agents to mitigate the genotoxic effects of contaminants formed during thermal processing, such as acrylamide. Incorporating such antioxidant-rich plant materials into the diet could represent a valuable strategy for reducing genotoxic risk associated with processed foods. Moreover, this study provides a basis for further research aimed at identifying and characterizing the specific bioactive constituents responsible for this protective effect, as well as understanding their mechanisms of action in relevant biological systems.

Future investigations should also consider more complex *in vitro* test systems such as 3D cell models and the impact of food matrix and processing on the bioavailability and efficacy of these compounds, ultimately contributing to the development of safer and healthier food products.

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IZVLEČEK

Antigenotoksični učinki izvlečkov tatarske in navadne ajde, rutina in kvercetinina na poškodbe DNA, povzročene s prehranskim mutagenom akrilamidom

Raziskali smo antigenotoksične učinke metanolnih izvlečkov moke tatarske in navadne ajde proti poškodbam DNK, ki jih povzroča akrilamid. Akrilamid je toksičen kontaminant v hrani, prvič identificiran leta 2002 po njegovem odkritju v živilih na Švedskem. Naši rezultati so pokazali, da tako tatarska kot navadna ajda pomembno zmanjšata obseg poškodb DNK. Znano je, da tatarska ajda vsebuje višje koncentracije rutina, kvercetinina in polifenolov ter izkazuje večjo antioksidativno aktivnost v primerjavi z navadno ajdo. Zaradi prisotnosti encima rutin glikozidaze, se je del rutina pretvoril v kvercetin. Antioksidativna aktivnost se je po obdelavi večinoma zmanjšala, izjema je bil pšenični kruh, kjer je prišlo do rahlega povečanja, verjetno zaradi Maillardove reakcije. Med termično obdelavo živil z visokim deležem ogljikovih hidratov se med termično obdelavo pri visoki temperaturi (pečenje, cvrtje, praženje) kot stranski produkt Maillardove reakcije, ki poteka med sladkorji in aminokislinami, tvori akrilamid. Le-ta ima v večjih količinah škodljiv vpliv na zdravje, saj deluje mutageno, kancerogeno in nevrotoksično.

Potrdili smo, da akrilamid povzroča genotoksične učinke v celicah HepG2 pri vseh testiranih koncentracijah (0,3125; 0,625; 1,25 in 2,5 mM) po 24-urni izpostavitvi ter da metanolni ekstrakti ajde učinkovito zmanjšajo obseg z akrilamidom povzročene poškodbe DNK. Pri tem je bil najbolj učinkovit metanolni ekstrakt tatarske ajde, ki je bil pri tem celo učinkovitejši kot sam rutin ali kvercetin v višjih koncentracijah. Rezultati kažejo, da kljub nastajanju potencialno škodljivih spojin, kot je akrilamid, med termično obdelavo hrane, lahko živalske matrice hkrati vsebujejo bioaktivne spojine, ki te negativne učinke omilijo ali celo izničijo.

Research Paper

The Influence of Foliar Application of Selenium (VI) on the Concentration of Fe, Mn, Cd, Cu, Zn, S, and Mo in Common Buckwheat

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Keywords: common buckwheat, Tartary buckwheat, selenium, trace elements

ABSTRACT

Selenium in the form of selenate (Se VI) was foliarly applied to buckwheat plants to evaluate its influence on the uptake and accumulation of other selected elements, including copper (Cu), zinc (Zn), sulfur (S), molybdenum (Mo), iron (Fe), manganese (Mn), and cadmium (Cd). Among these, Cu, Zn, Mo, Fe, and Mn are essential elements while cadmium, on the other hand, is a toxic pollutant absorbed by plants from contaminated soils. Foliar selenium (VI) application resulted in modest changes in the concentrations of Cd, Mo, Fe, Mn, and S in the leaves; Cu in the husks; and Mo and Mn in inflorescences. However, selenium had no significant effect on Zn accumulation. These results suggest that foliar application of selenium (VI) may both enhance and inhibit the uptake of specific elements, with effects varying by plant tissue.

INTRODUCTION

Common buckwheat (*Fagopyrum esculentum* Moench) is a traditional crop that has nearly fallen out of widespread cultivation, despite its high nutritional value and various health benefits. It is a rich source of minerals such as zinc, copper, and magnesium, and contains significant levels of B-group vitamins (B1, B2, niacin, and B6) (Bonafaccia et al., 2003). Furthermore, buckwheat harbors a variety of bioactive compounds with antioxidant properties, including phytosterols, phenolic acids, squalene, fagopyritols, and, notably, high concentrations of polyphenols, particularly flavonoids such as rutin and quercetin (Fabjan et al., 2003).

Selenium is an essential trace element for humans and animals but is often deficient in the diet. Enriching plants with selenium may increase its dietary intake and simultaneously improve the nutritional quality of the crop. Selenium content in plants depends largely on the selenium concentration in the soil, which in many regions is insufficient to meet the daily human requirement (55 µg Se/day) (National Research Council, 2000). Various methods can be used to increase selenium levels in plants, including soil supplementation (Kitaguchi et al., 2008), seed soaking in selenium solutions, hydroponic or aeroponic cultivation using selenium-enriched nutrient solutions, and foliar application (Hawkesford et al., 2007). In addition to the total selenium concentration, the chemical form (species) of selenium within the plant is also critical, as it affects bioavailability and toxicity.

To further enhance the functional value of buckwheat, we applied foliar application of selenium (VI) in our studies. Previously (Vogrinič et al., 2009), we studied selenium species in foliar Se enriched buckwheat plants. Over 63% of water-soluble selenium species accumulated in seeds, around 14% in stems, leaves, and inflorescences, and less than 1% in husks. The predominant selenium species in seeds was selenomethionine (SeMet, ~60% of total Se). In stems, leaves, and inflorescences, only selenate [Se(VI)] was detected (up to 10% of total Se), while no water-soluble selenium species were confirmed in husks. Notably, selenite [Se(IV)] showed instability in seed extracts, likely due to interactions with matrix components.

The aim of this study was to simultaneously investigate if foliar selenium (VI) supplementation would influence concentrations and distribution of selected elements (Fe, Mn, Cd, Cu, Zn, S, Mo) in different plant organs of buckwheat.

MATERIALS AND METHODS

Study was conducted on common buckwheat (*Fagopyrum esculentum* Moench), cv. Darja. The experiment was performed at the experimental fields of the Biotechnical Faculty of the University of Ljubljana in Kleče, Slovenia. At the onset of flowering, experimental plants were sprayed with a selenium solution containing 10 mg Se(VI)/L. Sampling was performed at two time points: 65- and 79-days post-sowing. Multiple random plant samples were collected, air-dried, and ground.

Total selenium concentration in plant tissues was measured using hydride generation atomic fluorescence spectrometry. The concentrations of other elements were determined using inductively coupled plasma mass spectrometry (ICP-MS). Detailed methodology is described by Vogrinič et al. (2009) and Cuderman and Stibilj (2010).

RESULTS AND DISCUSSION

Selenium concentrations in untreated plants were low, while foliar-treated plants exhibited selenium concentrations 50- to 500-fold higher, depending on plant organ

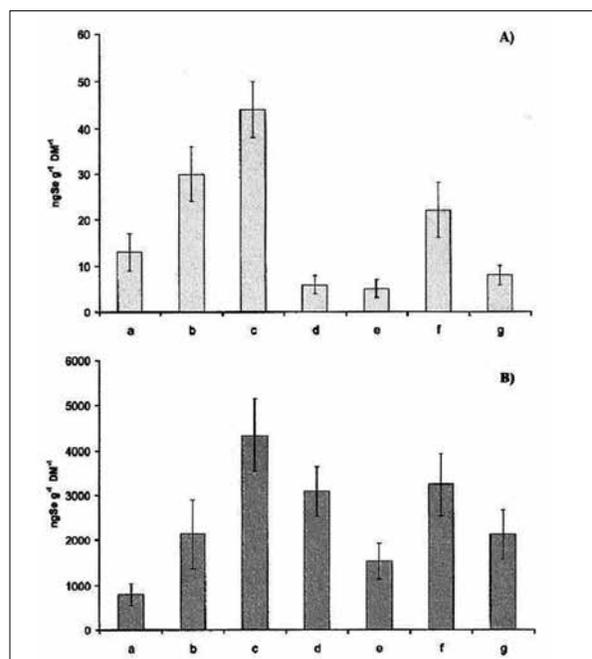


Figure 1. Distribution of Se in plant parts in control (A) and Se-enriched (B) group of buckwheat plants. a – stems; b – leaves; c – inflorescences; d – dehusked ripe seeds; e – husks of ripe seeds; f – dehusked unripe seeds; g – husks of unripe seeds (Vogrinič et al., 2009)

(ranging from 708 to 4231 ng Se/g dry weight). A similar distribution pattern of selenium across plant tissues was observed in both treated and untreated groups, with the most significant differences found in mature seeds.

Distribution of selenium among plant parts in the treated group followed the order: inflorescences > seeds

> leaves > husks > stems. Selenium concentrations did not significantly vary between sampling times, indicating limited temporal effects during the growth period.

Figures 2–4 illustrate the concentrations of Cu, Zn, S, Mo, Fe, Mn, and Cd in different plant parts from both control and selenium-treated groups.

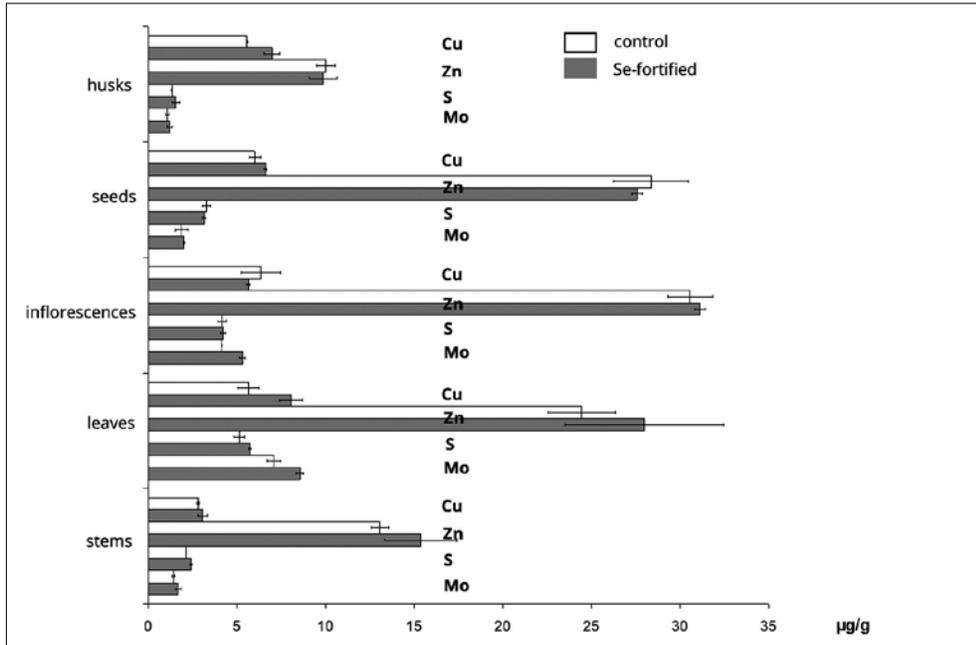


Figure 2. Content of Cu, Zn, S, and Mo (µg/g dry matter) in various buckwheat plant parts.

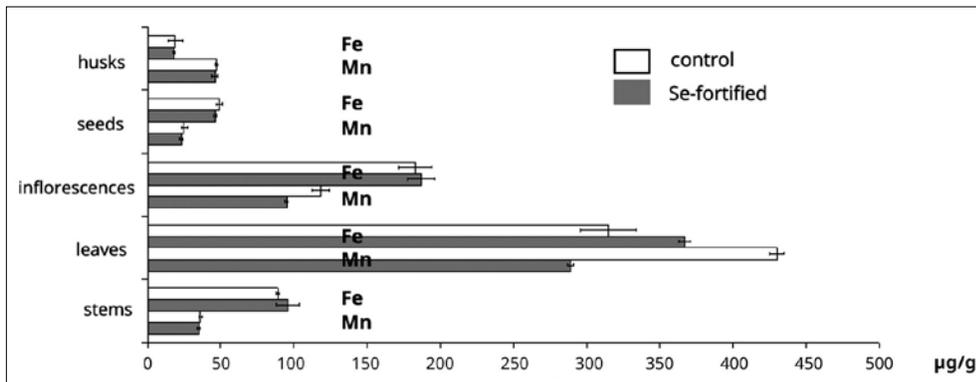


Figure 3. Concentrations of Fe and Mn (mg/g dry matter) in different plant parts.

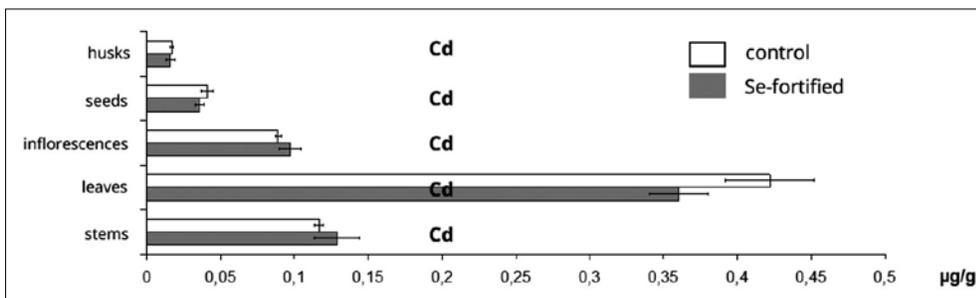


Figure 4. Cadmium levels in distinct buckwheat plant parts (µg/g dry matter).

Foliar selenium treatment induced minor changes in Cd, Mo, Fe, Mn, and S levels in leaves; Cu levels in husks; and Mo and Mn concentrations in inflorescences. However, Zn content remained unaffected by selenium

application. These findings suggest that selenium can influence the uptake and accumulation of certain elements, depending on their chemical interactions and specific plant organ.

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IZVLEČEK

Vpliv foliarnega dodajanja selenata na koncentracijo Fe, Mn, Cd, Cu, Zn, S in Mo pri navadni ajdi

Rastlinam ajde smo v začetku cvetenja foliarno dodajali selen (VI), da bi ugotovili njegov vpliv na privzem in vsebnost izbranih elementov, kot so baker (Cu), cink (Zn), žveplo (S), molibden (Mo), železo (Fe), mangan (Mn) in kadmij (Cd). Cu, Zn, Mo, Fe, S in Mn so esencialni elementi, ki jih rastline potrebujejo za rast, nalaganje Cd v rastlinah pa je posledica onesnaženja in je lahko v velikih koncentracijah toksičen za rastline. Foliarno dodajanje selena in posledično povečanje koncentracije tega elementa v rastlini je vplivalo na manjše spremembe v koncentracijah Cd, Mo, Fe, Mn in S v listih, Cu v luščinah ter Mo in Mn v pediclih. Dodajanje selena pa ni imelo vpliva na koncentracijo Zn. Rezultati analize kažejo, da lahko dodajanje selena vpliva tako na povečan kot zmanjšan privzem nekaterih elementov, to pa je odvisno tudi od posameznega dela rastline, ki ga opisujemo.

Research Paper

Cases of Buckwheat Tourism in Korea

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ABSTRACT

Buckwheat tourism in Korea in two places, Bongpyoung town, Pyoungchang county, Gangwon province and Wahul village, Jeju city, Jeju province, is introduced in terms of background, current activities, and expected effectiveness from green tourism point of view.

INTRODCUTION

Green tourism is characterized by its respect for the environment and preservation of biodiversity. The main objective is to reduce the carbon footprint by avoiding activities that harm the environment or use too many resources. The purpose of green tourism, as a part of sustainable tourism is to achieve a balance between “healthy” environment, heritage integrity, social well-being and economic benefits. Green tourism philosophy is adopted by a wide range of tourism operators, e.g. small lodgings (B&B’s), hotels, farms, retailers, etc. Green Tourism involve sustainable tourism practices, such as the use of renewable energy, good waste management, and reducing the carbon footprint. For example, eco-friendly hotels use solar or wind energy to meet their energy needs, reduce water and energy use, and recycle waste. Sustainable tourism focuses on sustainability in general, based on the pillars of sustainable development, whereas ecotourism focuses on protecting the environment and raising awareness of nature conservation.

The attractive ecological resouces are essential for the successful green tourism. The ornamental values of buckwheat flower blossom and human’s activities in nature without energy use have a geat potential for green tourism. Ethnobotanical knowledges of buckwheat also extend peoples’ interest to wide and practical use of buckwheat (Kreft et al., 2003). Buckwheat use for economic and cultural advances has been led by civilians (Park & Choi, 2004; Park, 2019). This article deals with some instances of buckwheat tourism as an approach of green tourism in Korea.

THE OLDEST BUCKWHEAT FLOWER FESTIVAL IN BONGPYOUNG TOWN, PYEONGCHANG COUNTY, KOREA

The buckwheat flower festival named officially Hyoseok Culture Fesitival was initiated in 1999 at Bongpyoung town where Mr. Hoyseok Lee was born in April 5, 1907. He was a novelist and essayist and won fame as a short-story writer representative in Korea. He was also a professor of English literature in Sungsil college and Dae-dong technical professional school. In 1936, he wrote a short story named “When the buckwheat blooms” with a buckwheat field in his hometown setting. The novel was criticized as a highlight short story in Asia by a number of literature critics. Bongpyoung has been a main producing district of buckwheat in Gangwon province until 1990s

after he died of illness in 1945. There are still a number of buckwheat processing manufactures and buckwheat restaurants in Bongpyoung town, calling ‘buckwheat town’. Bongpyoung inhabitants organized a commitee to



Figure 1. Poster inviting visitors to buckwheat festival in Bongpyoung in 2024.



Figure 2. Bongpyoung: a view on the city, famous for flowering buckwheat and a buckwheat festival.



Figure 3. A traditional buckwheat farm near Bongpyoung.



Figure 4. Visitors on buckwheat field in Bongpyoung.



Figure 5. Monument for the literature of Hoyseok Lee in Bongpyoung

praise his literary accomplishment and memory his life and have held every year Hyoseok culture festival since 1999. The festival open every fall in area of 200,000 m² of buckwheat field including period when the moon is full. The festival is continued for 10 days from middle of 1st week to end of 2nd week in September. The number of inhabitants is 5,828 people (3,061 households) in 2023, but visitors to Bongpyoung during the festival are about 300,000 (50 times of inhabitants). The main events of Hyoseok culture festival include buckwheat field tour, enjoying buckwheat food and folklore, contest in writing and drawing, literature concert including poem recitation, music and dance performances, sales of agricultural products etc. The features of Hyoseok culture festival are harmony with maintained natural landscape (ecological



Figure 6. Recording for TV on the field in Bongpyoung.



Figure 7. Performance on the buckwheat field in Bongpyoung



Figure 8. Children playing on buckwheat field



Figure 10. Traditional buckwheat pancakes with vegetable filling.



Figure 11. Baking traditional buckwheat pancakes.



Figure 9. Local buckwheat dish (Maemilmuk)



Figure 12. Traditional Korean buckwheat pasta.



Figure 13. Folk dance performance at buckwhwat festival in Bongpyoung.

resources such as buckwheat), all-generations programs for tour with family, deep understanding of Hyoseok Lee's literature, and government (The ministry of culture & tourism)-authorized festival of excellence. The inhabitants increase income through food sale, lodging, souvenir sale, and sale of buckwheat processing products and local agricultural products including buckwheat grains and flour. Pyoungchang local government provide subsidy to land owners of buckwheat field used for the festival.

From green tourism point of view, Hyoseok festival (in other words: Buckwheat flower festival) has been employed as a model by other local government or communities. Other several buckwheat festivals in Gochang, Hadong, Cheongju, Yeongwol, and Jeju across the nation were followed to Bongpyoung even though their scale and contents were little different among the regions.

WAHUL BUCKWHEAT VILLAGE IN JEJU ISLAND, KOREA

Jeju island is the warmest region in Korea but has also highland with cool weather. That is why buckwheat grow well in Jeju island. Since 2005, Jeju provincial government (JPG) had greatly interested and planned to develop buckwheat as a special crop in Jeju. Above all, pride of inhabitants in Jeju has attracted such provincial government's new policy for buckwheat promotion. There is a birth myth named 'Zacheongby' in Jeju island. Zacheongby was an agricultural goddess who brought buckwheat seeds with other four grains from heaven to

Jeju island when Jeju island was established. JPG enacted a local ordinance to develop buckwheat industry and to support it in 2015. JPG established by itself a number of projects to raise buckwheat industry based on the ordinance. Research and development for breeding cultivars adapted well to Jeju environment and for creating new buckwheat dishes with harmonizing traditional buckwheat food in Jeju are being contentously developed until a recent date. One of JPG's goals is to attract more tourists from other regions as well as from other countries. JPG nominated Wahul village as a buckwheat village and supported to build a guest house for tourists' lodging and to encourage village's buckwheat business with various programs.

Wahulri ('ri' means village in Korean) is located at the northern slope of Halla mountain and is surrounded by Gugeneoreum and Semioreum('oreum' is local language of hill). Wahul is a hilly and mountainous area with a vast grassland. The mountains look like a lie and named as Wahul. Most of inhabitants are farmers of special crop or stock farm. 70 percent of farmers produce orange. Many tourists visit Wahul village with favorable conditions of B&B, nearby tourist resort, and traffic network compare to other villages. The inhabitants in Wahul village are 802 people (335 households). Wahul has nominated as a buckwheat digitization village in 2005, as an outstanding natural ecology village and a rural healthy longevity village in 2009, and as a festival village of small community with traditional arts in 2012. A comprehensive development for creative village was done at Wahul in 2014. A building was constructed in Wahul village for experience and healing using buckwheat in 2018. Wahul was nominated as a rural experience and rest village in 2019 and was followed by restoration project of amenity from 2020 to 2022. In 2020, Wahul was nominated as a ruling base for rural new revitalizing plus and concentrated for the establishment of Jeju rural infrastructure and development of specialized products from 2021 to 2024. Buckwheat is not only an ecological resource for green tourism but also a special crop for economic and cultural promotion of the village.

Buckwheat festival in Wahul village is holding twice a year, spring and fall for 16 to 19 days. The main programs of festivals are buckwheat field tour, making buckwheat flower wreath, music performance (saxophone, accordion, ocarina etc.), exhibition and enjoying of buckwheat food, sale of buckwheat products, making buckwheat pillows etc.

In conclusion, contemporary is consilience era between science and culture. The humanistic value with scientific pragmatism is very important for sustainable high-quality life. The wide range of buckwheat use open the way of realizing integral value through green tour-

ism. Why should we understand and use well buckwheat? Buckwheat give us health to both body and mind. This is answer to know through buckwheat tourism anywhere whenever.

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IZVLEČEK

Primeri vključitve ajde v turistične dejavnosti v Koreji

Na dveh korejskih lokacijah, v mestu Bongpyoung, okrožje Pyeongchang (Pjongčang), provinca Gangwon in v vasi Wahul, pri mestu Jeju, provinca Jeju, so ajda, ajdova polja in ajdove jedi na široko vključeni v turistične dejavnosti. V prispevku je predstavljeno ozadje, trenutne dejavnosti in pričakovani učinki vključevanja ajde z vidika zelenega turizma.

First information on the 16th International Buckwheat Symposium in 2026 in Xichang, Sichuan, China

We received from Dr. Meiliang Zhou the first information on the **16th International Buckwheat Symposium**. The 16 ISB dates will be **24 June to 28 June 2026**, the host city is Xichang, Sichuan, China.

24 June 2026 is the registration day, and
25 June to 27 June is the academy congress,
28 June is the visiting buckwheat field day.

The meeting place is Qionghai Hotel, which is close to Qionghai lake in Xichang. Xichang is the city of Tartary buckwheat, and have many buckwheat processing factories.

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After reviewing by two reviewers and accepting the paper, the editorial office will ask the authors to provide the original figures if the first submission will not be adequate. Your manuscript should be sent to the Editor-in-Chief (Prof. Ivan Kreft). E-mail: **ivan.kreft@guest.arnes.si**

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 - Title (the title should be as short as possible, but should contain adequate information to indicate the contents)
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 - Affiliation(s)/Adress(es), including e-mail addresses of all authors (coauthors).
2. Key words/Running head (not to exceed 50 letters including spaces) (page 2)
 - Key words (maximum of 8, in alphabetical order, suitable for indexing)
3. Abstract (brief and informative, not to exceed 250 words).
4. Main text
 - Introduction, Material and Methods, Results, Discussion
 - The relative importance of headings and subheadings should be clear.
5. The approximate location of figures and tables could be indicated in the margin or in the text.
 - The use of footnotes is to be avoided.
6. After the main text
 - Acknowledgements (also grants, support etc., if any) should follow the text and precede the references.
7. References

Abstract in Slovenian will be for foreign authors made by the editors.

Review papers are welcome, main text has to be organised according to authors' suggestion.

The literature references should be arranged alphabetically, in the text referred to as: author and year of publication, e.g., Budagovskaya (1998), (Inoue et al., 1998). At the end of each literature citation at references should be, when possible a doi number in this way (for example <https://doi.org/10.3986/fag0040>)

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We encourage you to share these information and links with your colleagues.

The papers sent to editor latest on **October 30, 2025**, will be published after the 4th EuroIBRA event. In FAGOPYRUM journal it is for now no charge of publication fee for authors.

Best regards,
Ivan Kreft