Health-Active Compounds in Buckwheat Products

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Health-Active Compounds in Buckwheat Products

- Introduction
- Composition of major nutrients
- Protein / Amino Acids
- Further Nutrients
- Fagopyritols
- Antioxidatives
  - Flavonoids
- Further Secondary Compounds
- Buckwheat Herb as Medicinal Product

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Introduction

- *F. esculentum* MOENCH and *F. tataricum* (L.) Gaertn. originally from southeast Asia
- Staple crop during 17\textsuperscript{th} – 19\textsuperscript{th} century
- Sharp decline beginning 20\textsuperscript{th} century
- 1940s Buckwheat herb as source of rutin
- 1990s: Buckwheat becomes a nutraceutical
World total 2.348 m tonnes
Wheat in comp. 715 bn tonnes
= 0.0003 % of wheat production
Comparison of proximate composition with other crops (Ahmet A et al 2014)
Buckwheat Fibre

- Free of phytic acid
  - Strong binding affinity to minerals such as Calcium, Iron, Zinc,
  - Complexation of niacin
  - → reduced absorption

(Steadman et al 2001)
Essential Amino Acid Composition

Comparison of essential amino acids in the protein portion (Ahmet A et al 2014)
Buckwheat Protein

- Rich in lysine, aspartic acid and arginine
- Low glutamic acid and proline content
- Albumins, globulins → major storage proteins
- Prolamin and glutelin → minor proteins
- Very high biological value ~ 93.1 % (wheat 62.5%, maize 64.3%)
- No gluten type proteins
- Proteins with disulphide bonds appear to cause allergic response
- Low digestability in humans and animals caused by protease inhibitors and tannins

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Buckwheat Protein

- Resistant proteins → fibre comparable effects, lower blood cholesterol
- Good lysine/arginine and methionine/glycine ratios → lower blood cholesterol
- B. protein isolates show more intensive LDL and VLDL lowering effect than other plant and animal proteins
- B. protein isolates lower activity of angiotensin converting enzyme (ACE) and directly control hypertension
- B. protein even suppresses colon carcinoma risk → resistant proteins promote the formation of short chain fatty acids
Further Buckwheat Nutrients

- **Fatty Acids**
  - Major classes palmitic (16:0), oleic (18:1) and linoleic (18:2) acid (Becker 2008)

- **Minerals**
  - No big differences in comparison to other cereals (Ikeda et al 2006)

- **Vitamins**
  - High levels of vitamins B₁ (thiamine), B₂ (riboflavine), B₃ (Niacin and niacinamide) and E (tocopherol) (Ikeda et al 2006)

- **Iminosugars**
  - D-Fagomine has a strong inhibitory effect on α-glucosidase and β-galactosidase → lower the risk of insulin resistance (Amézquita et al 2012)

D-fagomine

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- Ex-galacoyl-derivatives of D-chiro-inositol
- Constitute 0.5 % of total soluble carbohydrates
- Inositol and its derivates have the potential to show a positive influence on the development of type II diabetes

(Obendorf et al 2008)
Antioxidant Activity

- Hierarchy of antioxidant activity in cereals [methanolic extracts]
  → buckwheat > barley > oat > wheat > rye (Zielinski, Kozlowska 2000)
- Main antioxidative compounds are the flavonols rutin, its aglycone quercetin, further quercetin glycosides, epicatechin and derivatives, hydroxycinnamic esters chlorogenic acid...

Antioxidation mechanism (Phenol as example)
Tartary buckwheat seeds contain higher concentrations (~19 mg/g) than common buckwheat (~0.3 mg/g) (Jiang et al 2007)
Further Secondary Compounds

- **Fagopyrins**  
  (Benkovic T, Kreft S 2015)  
  - Structurally close related to Hypericin in St. John’s Wort  
  - ~ 0.2-0.8 mg/g in leaves; seeds  
  - Causing fagopyrism (high conc) → Phototoxic skin inflammation

- **Anthraquinons**  
  (Peng, LX et al 2014; Wu X et al 2015)  
  - Even found in other Polygonaceae e. g. Rhubarb  
  - About 1 – 4 mg/kg in dried herb and seeds  
  - Liver-protecting, anti-inflammatory effects  
  - Laxatives

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Buckwheat Herb as Herbal Remedy

- New phytotherapeutical medicine (1970s)
- Monograph No 07/2013:2184 of the European Pharmacopoeia 2016

**DEFINITION:**
Whole or fragmented aerial parts of *Fagopyrum esculentum* Moench, collected in the early flowering period prior to fruiting and dried immediately. Content: minimum 3.0 per cent of rutin (C27H30O16; Mr 611) (dried drug).

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Distribution of Rutin in the Plant

- Inflorescences
- Leaves
- Side leaves
- Side stems
- Stems
- Leaf stalks
- Side leaves
- Germ

Rutin in % of dried plant

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Clinical Applications

Effects
- Improvement of the microcirculation in capillaries and venuls
- Normalization of fluids and compounds exchange from capillaries and venuls
- Antioxidative

Mode of Action
- Inhibition of hyaluronidase
- Tightening of vessel walls
- Reduction of non physiological hyperpermeability and capillary fragility

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Summary

- Buckwheat is an interesting source of diversification within human nutrition
- As everything it should be utilized in moderate amounts
- Buckwheat herb is a valuable source of rutin and other antioxidants being used to treat venous insufficiency
Commemoration

Prof. Dr. Dr. Heinz Schilcher
The Father of the Reproducable Quality of Phytopharmaceutical Medicinal Products
University Professor at Marburg, Tuebingen, Berlin

Pharmaceutical research on:
Phytotherapy generally, Chamomille, Pumpkin seed, Hawthorn, St. John’s Wort, Buckwheat…

21.02.1930 Burgheim
† 17.06.2015 Immenstadt / Allgäu

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