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Swiss Society for Food Chemistry Young Scientist Awards 2019

Call for Applications

With the Young Scientist Awards, the Swiss Society for Food Chemistry (SFC, originally founded in 1887) wishes to honor annually two masters' or bachelors' projects with a reward of 3,000 and 2,000 CHF respectively, including a free three-year membership to the SFC.

The topic of investigation must correspond to the field of expertise of the SFC, namely food chemistry and related disciplines such as food technology, food science or food safety with a focus on analytical issues. Work submitted must have been completed in a Swiss University and been accomplished no later than two years prior to submission.

The due date for submitting 2019 applications will be November 2018 and all corresponding documents have to be sent to *info@swissfoodchem.ch*

The correspondence is made exclusively by email. Nominations will be evaluated by members of the SFC Committee according to the degree of originality and innovation, the quality and scope, as well as the overall impression of the research work.

The 2019 prizes will be presented during the upcoming Swiss Food Science Meeting 2019 (SFSM) which will be hold in Neuchâtel situated in the Jura foothills on the shores of the picturesque Lake Neuchâtel. Both laureates will have the opportunity to briefly present their work during a dedicated session.

I am pleased to present you herein the two research projects that were awarded in 2018 and look forward to receiving your innovative research results dealing with food science.

With kind regards,
Dr. Stefan Bieri, Vice President of the Swiss Society for Food Chemistry, E-mail: stefan.bieri@vd.ch

Viscosity of Cereal β-Glucan in the Gastrointestinal Tract

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Keywords: Dietary fiber · β-Glucan · MRI

Silvia Leuzinger received her master's degree in food science at ETH Zurich in 2016. During her studies, she gained first professional experiences in internships at the European Research Center for taste and feeding behavior in Dijon, France, at Kleiner Bäckerei-Konditorei as well as in Jowa in Zurich. Her first job after her studies was in research and development of flatev AG, a start-up that aims to revolutionize the flatbread market with a capsule-based flatbread baking device. Currently she holds a position in flavor research at Givaudan International SA. She received the Swiss Food Chemistry Young Scientist Award 2018 for her Master thesis 'Viscosity of cereal β-glucan in the gastrointestinal tract' conducted in the Laboratory of Food Biochemistry and supervised by Prof. Laura Nyström and Dr. Andreas Steingötter.

Background

Cereal β-glucan (BG) belongs to the soluble dietary fibers and is a mixed β-(1→3) and β-(1→4) linked linear polymer of D-glucose (Fig. 1). It is mainly found in the endosperm of oat and barley, and in the subaleurone layer of wheat.[1] BG has attracted growing interest due to its health benefits. The European Food and Safety Authority has approved two health claims for oat and barley β-glucan enriched food: oat and barley BG can reduce the blood cholesterol levels and attenuate the postprandial glycemic response. Both health benefits are generally linked to the capability of BG to form highly viscous solutions.[1] The aim of this thesis was to examine if BG increases the viscosity in the stomach, and if barley and oat BG vary in their behavior in the human stomach.

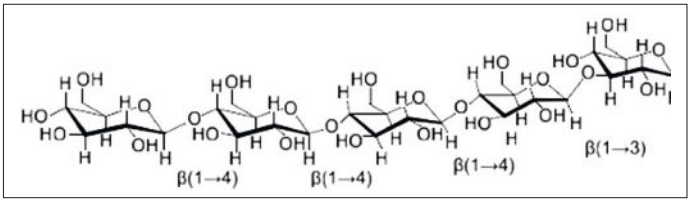

Fig. 1. Structure of cereal β-glucan, a mixed β-(1→3) and β-(1→4) linked linear polymer of D-glucose.[2]

For this purpose, the viscosity in the stomach of three subjects and stomach volume after ingestion of test meals containing oat or barley BG was monitored *in vivo* with magnetic resonance imaging (MRI). At the same time, blood glucose levels were measured with a blood glucose meter.

Results and Discussion

Oat and barley BG test meals had a higher viscosity in the stomach and delayed gastric emptying in comparison with the control (glucose solution). More free secretion in the stomach was found after ingestion of the oat BG test meal compared to the barley BG test meal, revealing that oat and barley BG seem to induce different gastric processing (Fig. 2). Different molecular fine structure or impurities in the extracts could explain these findings. Nevertheless, blood glucose levels were attenuated after both test meals compared to the levels after the control solution without β-glucan (data not shown).

Conclusion and Outlook

Cereal BG is known to exhibit multiple health benefits, for example attenuation of postprandial glycemic response and blood cholesterol lowering. The mode of action of BG is not fully understood yet; one assumption is that cereal BG increases the viscosity in the gastrointestinal tract. In the present study, a method to investigate the behavior of a BG test meal *in vivo* based on MRI was successfully developed. It could be shown that test meals containing BG are more viscous in the human stomach than a glucose solution used as control. Oat BG test meal induced more free secretion than barley BG test meal, indicating that the

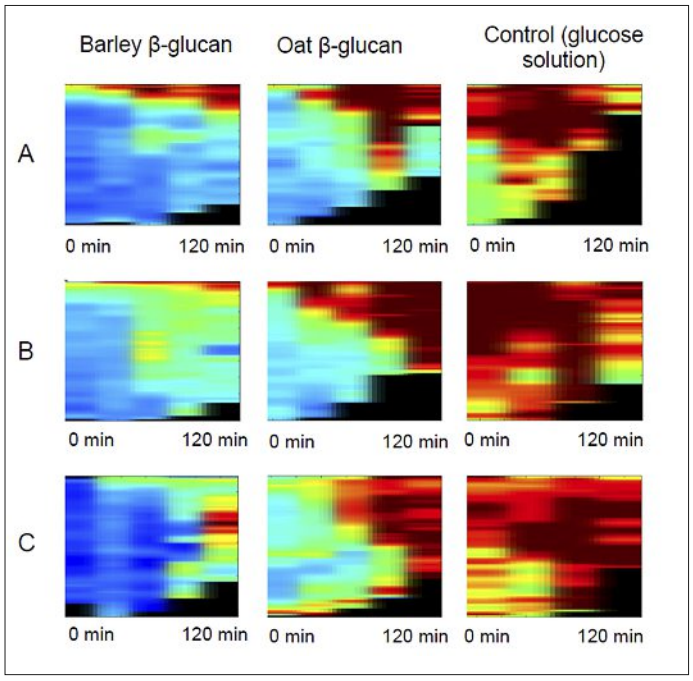

Fig. 2. Viscosity distribution of the stomach content over time. Three pictures in a row belong to the same subject (1, 2 or 3). x-axis is the time from 0 to 120 min and y-axis is the stomach volume in %. The colors indicate T1 volumes and therefore viscosities. Blue means low T1 and high viscosity, red means high T1 and low viscosity, and black indicates that the stomach volume decreased.

human body reacts differently to oat and barley BG. More secretion or variable mixing efficiency can be an explanation for the different amount of free secretion found. Despite the variable gastric processing of barley and oat BG, a slight attenuation of the postprandial blood glucose level could be found after ingestion of both test meals containing BG.

To confirm the results found in the present thesis, the *in vivo* study should be repeated with more subjects and extracts of higher purity. At the same time, secretion volume could be monitored *in vivo* by calibrating relaxation time T1 of the MRI against secretion volume *in vitro*. Thereby, the secretion volume could also be analyzed in data collected in the present *in vivo* study. Oat and barley BG structural differences should be further investigated, especially their characteristics and interactions in gastric environment. Moreover, the MRI method used here should be further advanced to be able to examine test meals in the small intestine. This would open completely new possibilities for investigating cereal BG in the human gastrointestinal tract and finally understanding the mode of action.

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[2] C. J. Rebello, C. E. O'Neil, F. L. Greenway, *Nutrition Rev.* **2016,** *74*, 131.

Sterol Profiles of *Cucurbitaceae* Plants

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Keywords: *Cucurbitaceae* · Hydrolysis · Phytosterols

Angela Pridal obtained her Bachelor's degree in Food Science from ETH Zurich in 2017, where she also completed her Bachelor thesis under the supervision of Prof. Dr. Laura Nyström and Dr. Aline Schär in the Laboratory of Food Biochemistry. After six months of industrial internship at Midor AG in Meilen, she spent three months at the Chalmers University of Technology in Gothenburg (Sweden). There, she worked on an analytical method for the quantification and characterization of avenanthramides in oats. Currently, she is doing her Master's thesis in the area of sensory science and 3D-extrusion techniques at HAFL in Zollikofen under the supervision of Prof. Dr.-Ing. Erich Windhab and Prof. Dr. Christoph Denkel.

Introduction and Motivation

Cardiovascular diseases are one of the most common causes of death worldwide.[1] The risk of having such diseases is heavily influenced by lifestyle and dietary habits. Additionally, it is very important to maintain an adequate blood cholesterol level and lipoprotein level. As too high levels of total and low-density lipoprotein (LDL) cholesterol increase the risk of cardiovascular diseases, the intake of high-cholesterol foods should be limited, while the consumption of foods rich in plant sterols should be encouraged. Plant sterols, also called phytosterols, are steroid alcohols that are essential structural elements in plant membranes. Moreover, they are highly likely to lower total blood cholesterol and LDL cholesterol levels by preventing the intestinal absorption of cholesterol in humans. The most prevalent sources of plant sterols are margarines and oils; however, they are also found in seeds, legumes and vegetables. The effect of phytosterols on cholesterol levels strongly depends on the sterol species. Therefore, it is important not only to investigate the total sterol content of plants, but also to analyze the sterol composition.[2,3]

Structure and Analysis of Phytosterols

Structurally, phytosterols belong to the group of triterpenes and are similar to cholesterol. They consist of a tetracyclic cyclopenta[a]phenanthrene ring and a long side chain at carbon 17 (Fig. 1).[2] Besides the number of methyl groups at carbon 4, phytosterols are also classified according to the position of the double bonds. Most commonly, the double bond is located between carbon 5 and 6 (Δ^5-sterols), but especially in *Cucurbitaceae* plants Δ^7-sterols may occur. In plants, phytosterols can be present not only as free sterols (FS), but also as steryl esters (SE), steryl glycosides (SG) and acylated steryl glycosides (ASG) [3].

Usually, sterols are analyzed in their free form after the hydrolysis from their conjugates. To cleave the glycosidic bonds in steryl glycosides and acylated steryl glycosides, either acid or enzymatic hydrolysis can be performed. Problematic is thereby that certain classes of sterols like the Δ^7-sterols undergo isomerization under acidic conditions.[3] To investigate how the sterol profile is influenced by the hydrolysis method, several plant species of the *Cucurbitaceae* family were analyzed either by acid or enzymatic

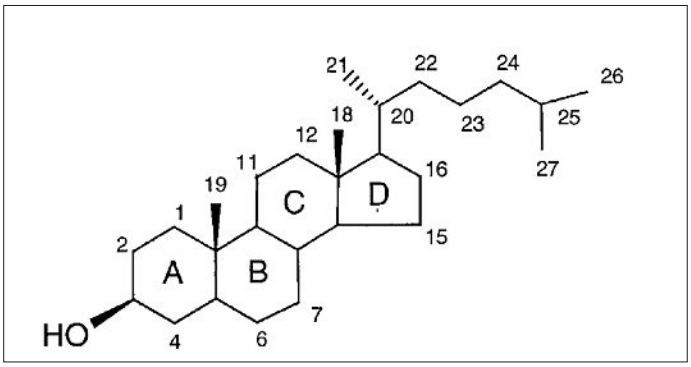

Fig. 1. Chemical structure of 5α-cholestan-3β-ol which represents the basic structure of phytosterols.[2]

hydrolysis. The *Cucurbitaceae* family was chosen due to their high content in Δ^7-sterols.

Total Sterol Content and Composition in *Cucurbitaceae*

The sterol profiles derived from acidic hydrolysis showed that zucchini and one type of pumpkin (*Cucurbita maximus* 'Hokkaido') contained the highest amount of plant sterols. The predominating sterol species in all samples were identified as spinasterol and an artifact of spinasterol (Fig. 2).[4]

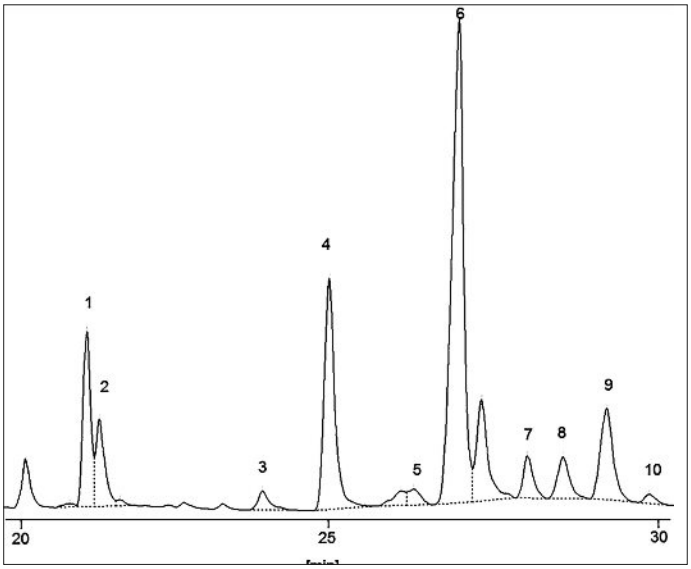

Fig. 2. GC chromatogram after acidic hydrolysis of pumpkin *Cucurbita maxima* 'Buttercup'; different numbers indicate different identities of the sterols; **1** Cholesterol; **2** Dihydrocholesterol; **3** Δ^7-Campesterol; **4** Artifact of spinasterol; **5** Artifact with m/z 484; **6** Spinasterol; **7** Artifact of poriferasta-7,22,25-trienol; **8** Poriferatsa-7,25-dienol; **9** Δ^7-Stigmasterol; **10** Δ^7-Avenasterol.[4]

Because of the very low recovery of the internal standard after enzymatic hydrolysis, the data from this analysis could not be evaluated completely. Consequently, a variety of modifications of the experimental parameters were conducted, in order to increase the recovery of the internal standard (Fig. 3). Nevertheless, it was not possible to achieve a sufficiently high recovery rate and further research on this method is needed.[4]

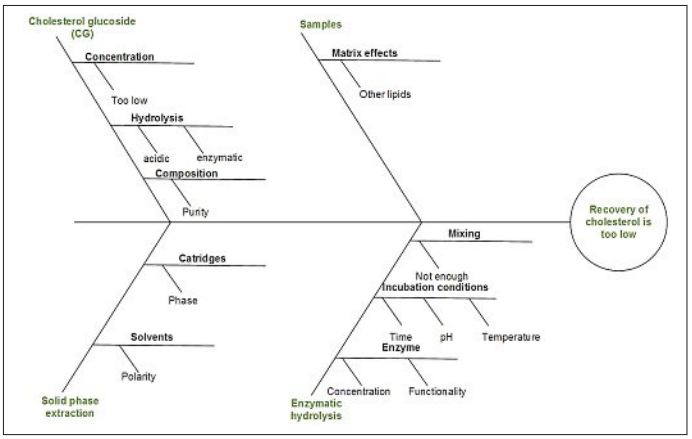

Fig. 3. Summary of the possible factors, which could be responsible for the low recovery of cholesterol glucoside (CG) after enzymatic hydrolysis.[4]

Conclusion and Outlook

The total sterol content and the sterol composition of different species of the *Cucurbitaceae* family could be analyzed by acid hydrolysis. Nevertheless, one should be aware that the sterol profiles derived under acidic conditions might be biased due to isomerization of certain sterol species. Therefore, the enzymatic hydrolysis is a promising method, but further research is needed to develop a working protocol.

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