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PHYSICOCHEMICAL AND FUNCTIONAL PROPERTIES OF FRUCTANS ISOLATED FROM SHATAVARI AND SUMA BY MICROWAVE-ASSISTED EXTRACTION

N. Petkova[1], D. Yaneva[2] and D. Vassilev[2]

[1]*University of Food Technologies, 26, Maritza Blvd., 4002, Plovdiv, Bulgaria (nadezhda_petkova@uft-plovdiv.bg)*

[2] *Technical University of Gabrovo, 4 Hadji Dimitar Str., 5300 Gabrovo, Bulgaria*

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ABSTRACT

The aim of the research was to characterise fructan isolated from roots of shatavari (*Asparagus racemosus* Willd.) and suma (*Pfaffia paniculata*) using microwave-assisted extraction. Its physico-chemical properties and functional properties (swelling, water and oil holding capacities, flowability and cohesiveness) were evaluated. The structure of inulin-type fructans was confirmed by FTIR spectroscopy, as the presence of 2-ketose and β (2→1) bonds were found. Shatavari fructan was characterized with low degree of polymerization 8 and molecular mass of 1.3 kDa, while suma polysaccharide is high-molecular fructan with degree of polymerization 24. The isolated fructans showed better oil-holding capacity than water-holding one, but low swelling properties. The research was the first detailed study for elucidation of structure and functional properties of inulin from shatavari and suma roots that reveal their potential for application in food, pharmaceutical and cosmetic purposes.

INTRODUCTION

Shatavari (*Asparagus racemosus*), is a medicinal plant from India and the Himalayas from Liliaceae family [1]. It was reported 26.7% yield of 2→1 linked fructo-oligosaccharides with degree of polymerization (DP) of nearly 7–8 in *Asparagus racemosus* roots with immunomodulatory activity [2].

Pfaffia glomerata (Spreng.) Pedersen, known also as suma or "Brazilian ginseng" is a medicinal herb from the Amaranthaceae family. It is distributed in Guyana, Bolivia, Argentina and Brazil [3,4]. Some authors isolated inulin with degree of polymerization (DP) of 13-15.33 [3, 4] with prebiotic activity [3]. Therefore, these two plants deserve attention for isolation of biologically active fructans. However, the information about carbohydrate composition is still insufficient and the functional properties were not evaluated well. This provokes the aim of the current research that is connected with fructan isolated from roots

of shatavari and suma using microwave-assisted extraction and evaluation of their physicochemical properties and functional properties.

EXPERIMENTAL

The organic shatavari root flour and suma root flour were purchased and obtained from FutuNatura (Slovenia). The isolation of shatavari and suma fructans was performed by boiling hot water microwave assisted extraction for 5 min [5]. The physicochemical properties were characterized [6]. The FTIR spectra were recorded on Jasco X6 (JASCO, Japan) spectrometer in the wavelength range of 4000–400 cm^{-1}, 132 scans at a resolution of 2 cm^{-1}. Color measurement was done by a portable colorimeter Model WR-10QC D 65 lighting [5]. Functional properties of fructans were evaluated [5]. True, bulk, and tapped densities, angle of repose, flowability and wettability were determined [6].

RESULTS AND DISCUSSION

The structure of shatavari and suma fructans was confirmed by FTIR spectroscopy (Fig. 1).

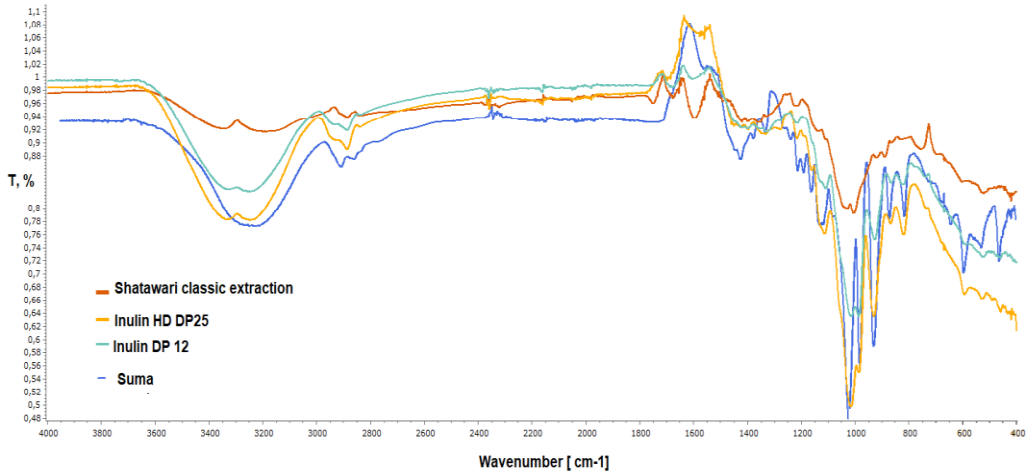


Figure 1. FTIR spectra of chicory inulin, shatavari and suma fructans.

FTIR spectra showed all typical bands for inulin-type fructans [5,6], as their bands were compared with chicory inulin standards (Frutafit HP with DP 9-12 and Raftiline HPX DP=25). The band at 3330 cm−1 was typical for OH groups, The bands at 1014 cm^{-1} were typical for C–O stretching vibration. The bands at 930-932 cm^{-1} showed α-D-glucopyranosyl residue, while the band at 873 cm^{-1} was due to 2-ketofuranose and β-anomer bendings in C1–H. The bands at 817-819 cm^{-1} confirmed the presence of 2-ketose in pyranosyl or furanosyl ring.

The results for the physicochemical characteristics of fructans isolated by microwave extraction were presented (Table 1). The yield of the suma

polysaccharide was low, with a low fructose content (17%) and inulin purity (10%), but it exhibited a high molecular mass and a degree of polymerization of 24 (Tab. 1). Our results were lower than the previously reported yield of 11.45 % obtained by classical hot-water extraction followed by ethanol precipitation [3]. However, the degree of polymerization of inulin from suma was higher than in some reports [3, 4]. Moreover, the colour characteristics of suma fructan were reported for the first time in this study, whereas those of shatavari were comparable to previously reported values [5]. However, shatavari fructan showed a better yield 6.8% with inulin purity of 62% and a high fructose content of 68%. The degree of polymerization is 8, and the obtained inulin from *Asparagus racemosus* can be evaluated as a low-molecular-mass fructan, part of fructooligosacchrides with a molecular mass 1375 Da. Therefore, our data on shatavari inulin were close to the reports in the literature [1, 5].

Table 1. Physicochemical characteristics of fructans isolated from shatavari and suma roots by microwave-assisted extraction

Characteristics	Shatavari inulin	Suma fructan	Inulin Frutafit HD DP 8-12
Yield , %	6.8±0.4	1.2±0.2	-
Purity, %	62.0±0.6	10.1±0.5	82.5±0.3
Fructose content, %	68.6±0.9	17.5±0.2	75.0±0.4
DP by HPLC-SEC	8	24	12
Mw, Da	1375	3951	2185
Mn, Da	1340	3757	2105
Polydispersity index	1.03	1.05	1.04
Color characteristics			
L	54.03 ± 1.50	72.81 ± 1.22	100.00±0.00
a	11.62 ± 0.47	8.27 ± 0.06	0.08±0.04
b	26.85 ± 0.91	18.11 ± 0.16	6.79±0.10
C	29.25± 0.52	19.91± 0.12	6.79±0.10
h	66.60± 0.41	65.45± 0.11	92.29±5.16

Legend: Mw- weight molecular mass, Mn – Number molecular mass, L- lightness, a – redness, b- yellowness, C- chroma, h – hue

The functional properties were summarized in Table 2. Both isolated inulin demonstrated with low swelling properties, but high oil-holding capacity, good water holding capacity and hygroscopicity. Wetting properties were close to those of the chicory inulin reference. Because of the low yield, some functional properties of suma fructan could not be determine. However, this was the first study for evaluation of the functional properties of suma fructan.

Table 2. Functional properties of isolated inulin from shatavari roots

Functional properties	Shatavari inulin	Suma fructan	Inulin Raftiline HD DP 8-12
Swelling, g/cm^3	0.17	0.09	0.74
Water-holding capacity, g water/g	5.52	3.88	0.40
Oil-holding capacity, g oil/g	8.30	8.41	0.40
Bulk density, g/mL	0.40	-	24
Tapped density, g/mL	0.47	-	18.5
True density, g/mL	0.47	-	1.11
Angle of repose,°	11.31	16.16	25.64
Higroscopicity, %	6.92	6.52	3.7
Wettability, s	11.7	11.5	9

CONCLUSION

The current study elucidated the structure, physicochemical and functional properties of inulin-type fructan from shatavari and suma roots. The obtained shatavari inulin was characterised as a low molecular mass fructan with DP 8 and an average yield, while suma fructan was a high molecular inulin. According to the obtained functional properties, shatavari inulin should be used as a taste modifier in food products with a potential prebiotic effect, because of its low molecular weight, while suma can be used as texture modifier.

REFERENCES

[1] R.S. Singh, R. Dhaliwal, M. Puri, *J. Ind. Microbiol. Biotechnol*., 2007, 34(10), 649 – 655.
[2] M. Thakur, P. Connellan, M. Deseo, C. Morris, W. Praznik, R. Loeppert, V.K. Dixit, *Int. J. Biol. Macromol.,* 2012, 50(1), 77.
[3] E. R. Caleffi, G. Krausová, I. Hyršlová, L. L. R. Paredes, M. M. dos Santos, G. L. Sassaki, R. A. C. Gonçalves, A. J. de Oliveira, *Int. J. Biol. Macromol*., 2015, 80, 392 – 399.
[4] S. T. C. Ribeiro da Silva, T. F. O. Castro, J. C. Cabral, M. R. P. de Abreu Filho, B. A. de Oliveira, A. J. B. and R. A. C. Gonçalves, *Bioact. Carbohydr. Diet. Fibre*, 2022, 27, 100303.
[5] D. Yaneva, I. Hambarlyiska, N. Petkova, I. Ivanov, D. Vassilev *Bulgarian Chem Commun*. 2025, 63, 1–6.
[6] N. Petkova, A. Petrova, I. Ivanov, I. Hambarlyiska, Y. Tumbarski, I. Dincheva, M. Ognyanov, P. Denev, C*hemEng*., 2023, 7, 94.