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POSSIBILITY OF APPLE POMACE APPLICATION IN ORDER TO INCREASE THE NUTRITIONAL VALUE OF CORN SNACK PRODUCTS

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Introduction

Apple pomace, as a main by-product in production of apple juice, cider and related products, is a nutritionally valuable raw material, rich in pectins, dietary fibres, polyphenols, etc. Because of that, apple pomace can be incorporated in various types of products, usually in production of cookies and bread. The aim of this research was to investigate the potential of apple pomace application in production of corn snack products. Dried apple pomace was added in corn grits in proportions of 5, 10 and 15%.

Materials and Methods

Corn grits used in this study was kindly provided by the mill Đakovo of the "Žito" Company Ltd. Osijek, produced in 2014. Apple pomace was produced on a hand press in 2013. Prepared samples with 15% of moisture content were extruded in the laboratory single screw extruder Do-Corder, Brabender, Germany. Extrusion parameters were as follows: screw: 4:1; die: 4 mm; temperature profile: 135/170/170 °C. Obtained extrudates were air-dried overnight and milled in laboratory mill prior the analysis. Total, soluble and insoluble dietary fibres (AOAC 991.43), resistant starch (AOAC 2002.02), starch damage (AACC 76-31.01), antioxidant activity (DPPH) and total polyphenols (Folin-Ciocalteu) (Wang and Ryu, 2013), acrylamide and hydroxymethylfurfural content (LC-MS/MS) were determined. All statistical analyses were carried out using software program STATISTICA 12.0 (StatSoft, Inc, USA).

Results

Table 1. Total, soluble and insoluble dietary fibres

Sample	NON-EXTRUDED			EXTRUDED		
	IDF [% d.m.]	SDF [% d.m.]	TDF [% d.m.]	IDF [% d.m.]	SDF [% d.m.]	TDF [% d.m.]
Corn grits	3.18 ± 0.03 ^{a}	0.21 ± 0.04 ^{a}	3.39 ± 0.01 ^{a}	1.73 ± 0.00 ^{a}	0.63 ± 0.03 ^{a}	2.36 ± 0.03 ^{a}
Corn : apple 95:5	4.44 ± 0.07 ^{b}	0.75 ± 0.09 ^{b}	5.19 ± 0.02 ^{b}	3.00 ± 0.11 ^{b}	1.57 ± 0.05 ^{b}	4.57 ± 0.05 ^{b}
Corn : apple 90:10	5.62 ± 0.07 ^{c}	1.29 ± 0.02 ^{c}	6.91 ± 0.08 ^{c}	4.16 ± 0.05 ^{c}	1.94 ± 0.05 ^{c}	6.10 ± 0.10 ^{c}
Corn : apple 85:15	6.89 ± 0.05 ^{d}	1.92 ± 0.02 ^{d}	8.80 ± 0.07 ^{d}	5.34 ± 0.07 ^{d}	2.53 ± 0.03 ^{d}	7.87 ± 0.10 ^{d}

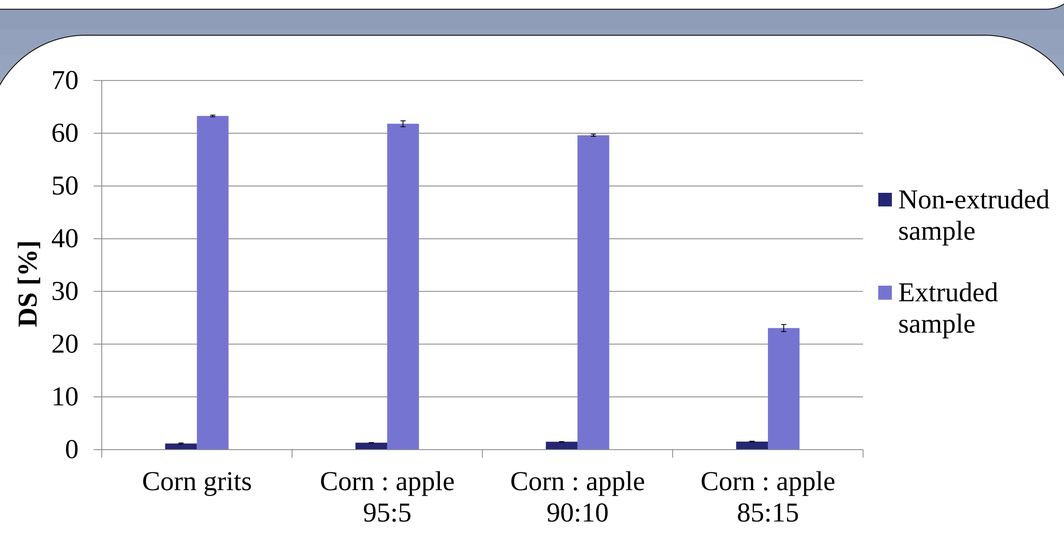

Fig. 1. Starch damage content of non-extruded and extruded samples

Table 2. Antioxidant activity and total polyphenols of non-extruded and extruded samples

Sample	TOTAL POLYPHENOLS [mg GAL/100 g d.m.]		ANTIOXIDANT ACTIVITY [% DPPH]	
	NON-EXTRUDED	EXTRUDED	NON-EXTRUDED	EXTRUDED
Corn grits	61.38 ± 1.64 ^{a}	48.39 ± 1.06 ^{a}	17.78 ± 0.03 ^{a}	19.51 ± 0.45 ^{a}
Corn : apple 95:5	240.37 ± 2.27 ^{b}	167.18 ± 2.7 ^{b}	24.65 ± 0.07 ^{b}	36.67 ± 0.00 ^{b}
Corn : apple 90:10	337.86 ± 2.21 ^{c}	285.36 ± 3.47 ^{c}	31.06 ± 0.60 ^{c}	54.80 ± 0.92 ^{c}
Corn : apple 85:15	421.09 ± 3.58 ^{d}	409.13 ± 6.03 ^{d}	38.31 ± 0.27 ^{d}	78.11 ± 1.08 ^{d}

Table 3. Acrylamide and hydroxymethylfurfural content of non-extruded and extruded samples

Sample	NON-EXTRUDED		EXTRUDED	
	AA [ngg^{-1}]	HMF [ngg^{-1}]	AA [ngg^{-1}]	HMF [ngg^{-1}]
Corn grits	n.d.	81.99 ± 2.68 ^{a}	2.48 ± 0.38 ^{a}	185.51 ± 4.58 ^{a}
Corn : apple 95:5	n.d.	420.56 ± 20.51 ^{b}	3.98 ± 0.07 ^{b}	970.52 ± 85.19 ^{a}
Corn : apple 90:10	n.d.	800.95 ± 37.86 ^{c}	4.93 ± 0.71 $^{b, c}$	2621.51 ± 110.43 ^{b}
Corn : apple 85:15	n.d.	1277.29 ± 11.04 ^{d}	5.37 ± 0.50 ^{c}	6068.52 ± 788.8 ^{c}

n.d. – not detected, i.e concentracion was <LOD (limit of detection)

Table 4. Resistant starch content of non-extruded and extruded samples

Sample	NON-EXTRUDED			EXTRUDED		
	RS [% d.m.]	NRS [% d.m.]	TS [% d.m.]	RS [% d.m.]	NRS [% d.m.]	TS [% d.m.]
Corn grits	8.01 ± 0.01 ^{c}	77.28 ± 0.00 ^{c}	85.29 ± 0.01 ^{d}	0.61 ± 0.00 ^{a}	83.75 ± 0.39 ^{c}	84.36 ± 0.39 ^{c}
Corn : apple 95:5	6.03 ± 0.16 ^{b}	76.73 ± 0.29 ^{c}	82.76 ± 0.45 ^{c}	0.64 ± 0.00 ^{b}	83.65 ± 0.03 ^{c}	84.29 ± 0.03 ^{c}
Corn : apple 90:10	5.94 ± 0.04 ^{b}	71.07 ± 0.18 ^{b}	77.00 ± 0.14 ^{b}	0.72 ± 0.00 ^{c}	78.21 ± 0.86 ^{b}	78.93 ± 0.86 ^{b}
Corn : apple 85:15	5.49 ± 0.23 ^{a}	59.58 ± 0.78 ^{a}	65.07 ± 1.00 ^{a}	1.05 ± 0.01 ^{d}	74.48 ± 0.52 ^{a}	75.52 ± 0.52 ^{a}

Conclusion

Addition of apple pomace significantly increased dietary fibres and polyphenol content, as well as antioxidant activity. After extrusion process starch damage and antioxidant activity significantly increased, while resistant starch content and total polyphenol content decreased. Furthermore, extrudates with higher portions of apple pomace had higher content of acrylamide and hydroxymethylfurfural, but these concentrations were low and it can be concluded that these products are safely for consumers. Results obtained in this investigation show that apple pomace can be successful incorporated in corn grits with the aim of production nutritionally more valuable corn snack products.

Acknowledgements

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Literature

Wang YY, Ryu GH: Physicochemical and antioxidant properties of extruded corn grits with corn fiber by CO_2 injection extrusion process. Journal of Cereal Science, 58(1):110-116, 2013.