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Nutritional impovement of milk and dark chocolate with treated and untreated cocoa shell

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Introduction

Chocolate is a product that has high content of sugar and fat and is one of the most craved foods in the world. In addition, chocolate is known as a source of polyphenols, which originate from cocoa beans. They are mostly catechin, epicatechin and their oligomers and polymers. Cocoa shell is a by-product of cocoa industry that is rich in dietary fibres but also in polyphenols that migrated from bean during fermentation, drying and roasting. Since chocolate is poor in dietary fibres that are beneficial to gastrointestinal health, addition of cocoa shell in this products can increase its nutritional value. The aim of this study was to examine effect of addition of cocoa shell on polyphenol and fibre content.

Materials and methods

Dark and milk chocolates (Table 1) were produced in laboratory ball mill at 55 °C with speed of mixing 60 rpm and mixing time 3 h (chocolate without cocoa shell) and 3.5 h (chocolate with cocoa shell). One part of cocoa shell used for production was treated with HVED (high voltage electrical discharge) and another part was untreated. Both cocoa shells were milled and fraction smaller than 70 μm was used. Cocoa shell and cocoa butter were added half an hour before other ingredients. Emulsifiers were added one hour before the end of mixing and vanillin half an hour before the end of mixing.

Table 1. Chocolate composition

Sample	Cocoa mass (%)	Cocoa butter (%)	Milk powder (%)	Untreated cocoa shell (%)	Treated cocoa shell (%)	Lecithin (%)
D0	36.00	21.57	-	-	-	0.40
DU5	31.00	21.57	-	5.00	-	0.40
DU10	26.00	21.57	-	10.00	-	0.40
DU15	21.00	21.57	-	15.00	-	0.40
DT5	31.00	21.57	-	-	5.00	0.40
DT10	26.00	21.57	-	-	10.00	0.40
DT15	21.00	21.57	-	-	15.00	0.40
M0	14.74	24.83	15.00	-	-	0.40
MU2.5	12.24	24.83	15.00	2.50	-	0.40
MU5	9.74	24.83	15.00	5.00	-	0.40
MT2.5	12.24	24.83	15.00	-	2.50	0.40
MT5	9.74	24.83	15.00	-	5.00	0.40

Total phenolic content

The modified Folin-Ciocalteu method performed under acidic conditions (without addition of Na_2CO_3) was used to eliminate sugar interference with Folin-Ciocalteu reagent. The absorbance was determined at 750 nm against the blank.

Dietary fiber

Dietary fibers were determined in treated and untreated cocoa shell according to gravimetric AOAC method 991.43. Content of dietary fibers in chocolates was obtained by calculation.

Color

Color of samples was measured with chromameter Konica Minolta CR-400. The measurement was carried out in the CIEL*a*b* system. Color of all samples was measured after cooling, 24 h, 48 h, one week, two weeks, one month and two months. Total colour change (ΔE) (1) and whiteness indeks (WI) (2) were calculated according to:

$$\Delta E = \sqrt{(L^* - L_0^*)^2 + (b^* - b_0^*)^2 + (a^* - a_0^*)^2} \quad (1)$$

$$WI = 100 - [(100 - L^*)^2 + a^2 + b^2]^{0.5} \quad (2)$$

Conclusions

- Total phenolic content (TPC) (Figure 1) was higher in dark chocolates compared to milk chocolates. With addition of cocoa shell TPC decreased and decrease was more pronounced with addition of treated cocoa shell.
- Treated cocoa shell had higher content of insoluble and total dietary fibers (Figure 2). Consequently, treated-shell chocolates had higher content of dietary fibers.
- Addition of cocoa shell in milk and dark chocolates caused higher total color change after two months in all chocolates (Figure 3). Also, whiteness index decreased after two months in all milk chocolates.

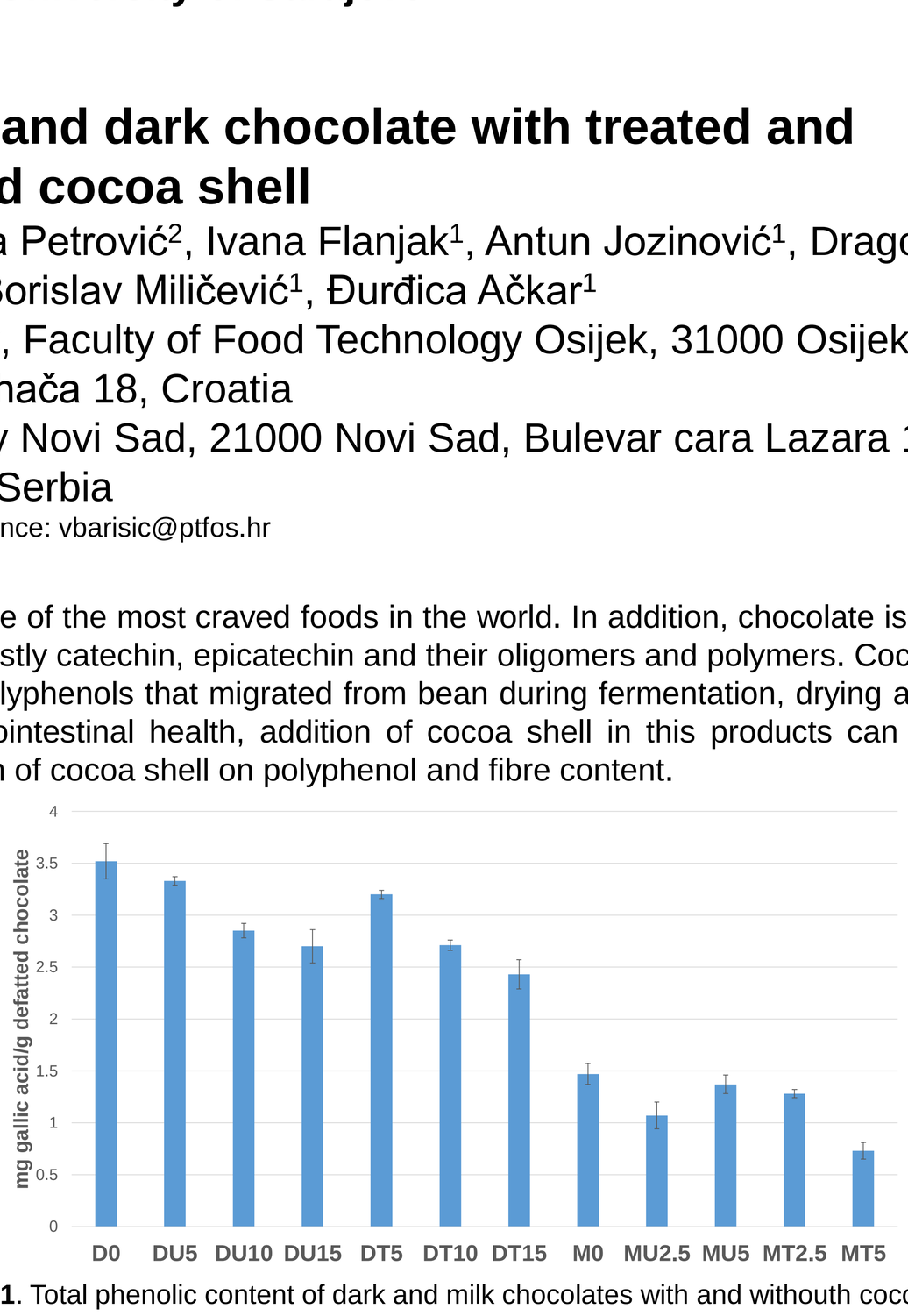

Figure 1. Total phenolic content of dark and milk chocolates with and withouth cocoa shell

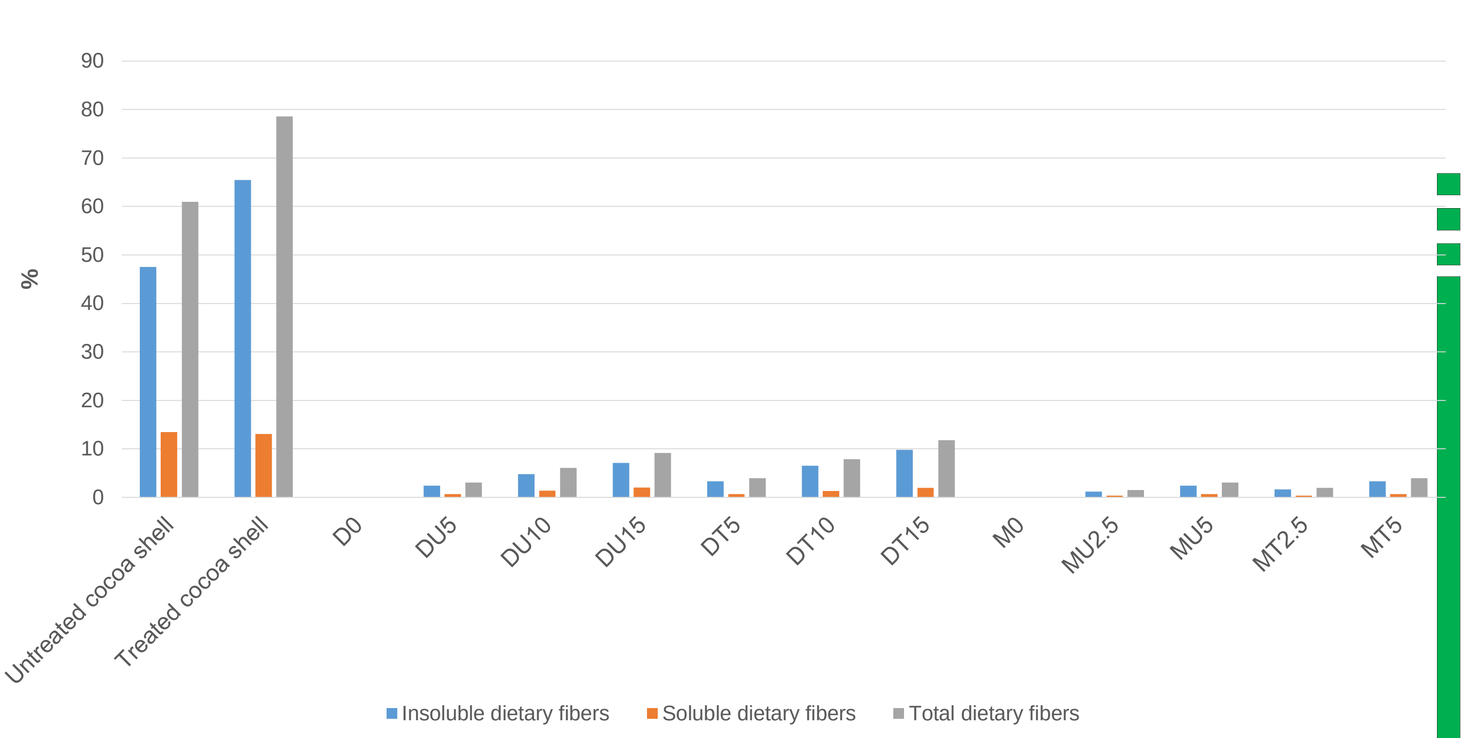

Figure 2. Dietary fiber content of dark and milk chocolates with and withouth cocoa shell

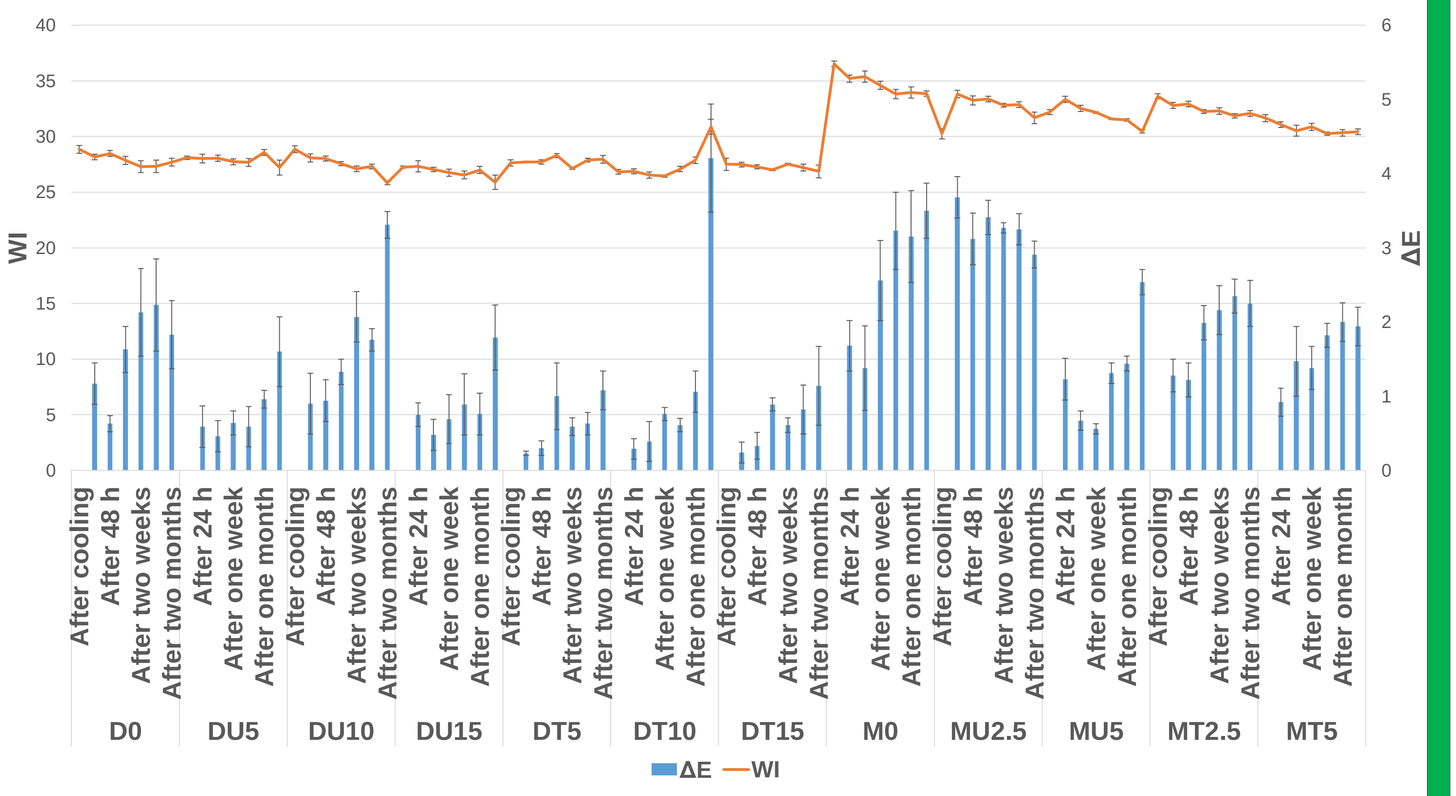

Figure 3. Total color change (ΔE) and whiteness index (WI) of dark and milk chocolates with and withouth cocoa shell

Acknowledgment

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