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EFFECT OF COCOA SHELL ADDITION ON PHYSICAL PROPERTIES OF CHOCOLATE

Veronika Barišić[1], Ivana Lončarević[2], Jovana Petrović[2], Ivana Flanjak[1]*, Antun Jozinović[1], Drago Šubarić[1], Jurislav Babić[1], Borislav Miličević[1], Đurđica Ačkar[1]

[1]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, 31000 Osijek, Croatia; *iflanjak@ptfos.hr

[2] University of Novi Sad, Faculty of Technology Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

Introduction

Chocolate is one of the most desirable confectionery products for consumers of all ages. Chocolate industry generates large amount of by-products in pre-processing and processing phases, among which is cocoa shell. It is separated from the bean before or after the roasting. Since this by-product is rich in dietary fibers, proteins, polyphenols and methylxanthines, it represents great material for the enrichment of nutritionally poor products. High voltage electrical discharge (HVED) is one of the new non-thermal treatments for extraction and decontamination. During HVED treatment shock waves, electrical discharges in water and generation of number of radicals are occurring. The aim of this study was to determine effect of addition of untreated and cocoa shell treated with HVED on physical properties of milk and dark chocolates.

Materials and methods

Cocoa shell samples

Untreated cocoa shell was obtained after roasting of cocoa beans (55 min at 135 °C). Treated cocoa shell was obtained after treatment with high voltage electrical discharge (HVED) in concentration 3%, at 40 Hz, during 15 minutes.

Chocolate production

Chocolates were produced in laboratory ball mill at 55 °C with speed of mixing 60 rpm and mixing time 3 h (chocolates without cocoa shell) and 3.5 h (chocolates with cocoa shell). Cocoa shell was added at the beginning with cocoa butter and after 30 min cocoa mass and sugar were added. Lecithin was added 1 h, and vanillin 30 min before the end of mixing. Table 1 shows the recepies of all samples. Chocolate mass was tempered (temper index 4-7), moulded and cooled (8 °C/30 min).

Texture

Texture Analyser TA.XT with „three point bending rig" was used for measurement of hardness and results are expressed as a gram of force needed to break the chocolate.

Particle size distribution

Mastersizer 2000 laser diffraction particle size analyzer was used for determination of particle size distribution. Specific surface area and volume weighted mean (D[4,3]) parameters were determined.

Rheological properties

Casson viscosity and yield stress were determined with rotational rheometer Rheo Stress 600 at 40 °C. Flow curves were determined by increasing share rate from 1 to 60 s^{-1} (during 180 s), keeping at 60 s^{-1} (during 60 s) and decreasing from 60 to 1 s^{-1} (during 180 s).

Table 1. Recepies of milk and dark chocolates

Sample	Cocoa shell type	Amount of cocoa shell (%)	Cocoa mass (%)	Cocoa butter (%)	Sugar (%)	Milk powder (%)
M0	-	-	14.74	24.83	45	15
MN2.5	Untreated	2.5	12.24	24.83	45	15
MN5	Untreated	5	9.74	24.83	45	15
MT2.5	HVED treated	2.5	12.24	24.83	45	15
MT5	HVED treated	5	9.74	24.83	45	15
T0	-	-	36	21.57	42	-
TN5	Untreated	5	31	21.57	42	-
TN10	Untreated	10	26	21.57	42	-
TN15	Untreated	15	21	21.57	42	-
TT5	HVED treated	5	31	21.57	42	-
TT10	HVED treated	10	26	21.57	42	-
TT15	HVED treated	15	21	21.57	42	-
*in all samples 0.4% of lecithin and 0.03% of vanillin was added						

Results

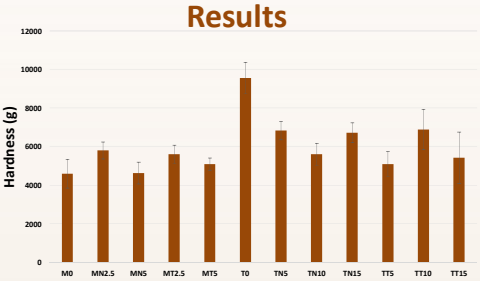

Figure 1. Hardness of milk and dark chocolates with different amounts of treated and untreated cocoa shell

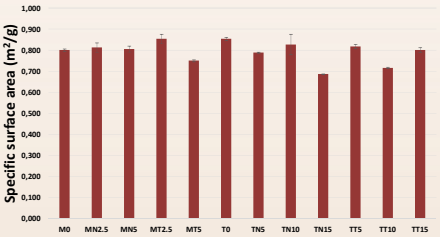

Figure 2. Specific surface area of milk and dark chocolates with different amounts of treated and untreated cocoa shell

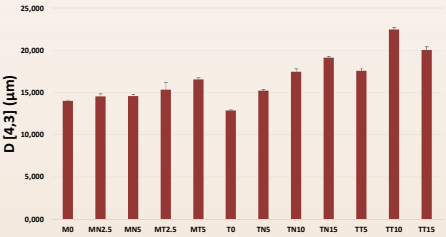

Figure 3. Volume weighted mean of milk and dark chocolates with different amounts of treated and untreated cocoa shell

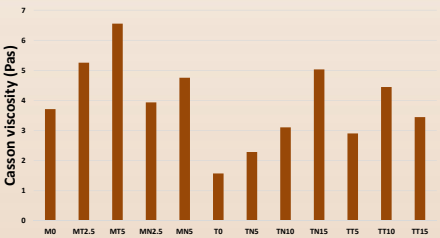

Figure 4. Casson viscosity of milk and dark chocolates with different amounts of treated and untreated cocoa shell

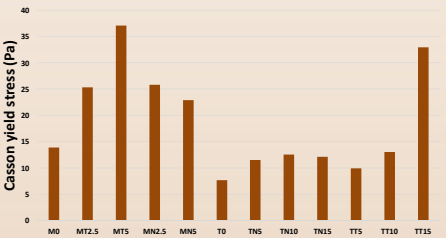

Figure 5. Casson yield stress of milk and dark chocolates with different amounts of treated and untreated cocoa shell

Conclusions

- Dark chocolates were harder than milk chocolates (effect of milk fat), but after addition of cocoa shell hardness increased for milk chocolates and decreased for dark ones.
- Volume weighted mean was higher in chocolates with added cocoa shell. HVED treated cocoa shell had greater effect on this parameter. Milk chocolates with added shell had higher, while dark chocolates had lower specific surface area.
- Casson viscosity and yield stress showed that dark chocolates had lower rheological values compared to milk chocolates. Also, addition of cocoa shell increased viscosity of chocolates, whereas HVED treated cocoa shell had a greater effect.

Acknowledgment

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