Stability of chocolates enriched with cocoa shell during storage

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Introduction

- Cocoa shell is one of the by-products of chocolate industry.
- Cocoa shell addition in chocolate would have nutritional and environmental benefits.
- The stability of chocolate is mainly influenced by cocoa butter re-crystallization during storage, shown through fat bloom.

Objective

- The aim of this study was to examine the influence of cocoa shell addition on stability of dark and milk chocolate over one year storage period.
- The effect of cocoa shell on chocolate stability was examined by determining total color change, whiteness index, total polyphenol content (TPC) and thermo-physical properties.

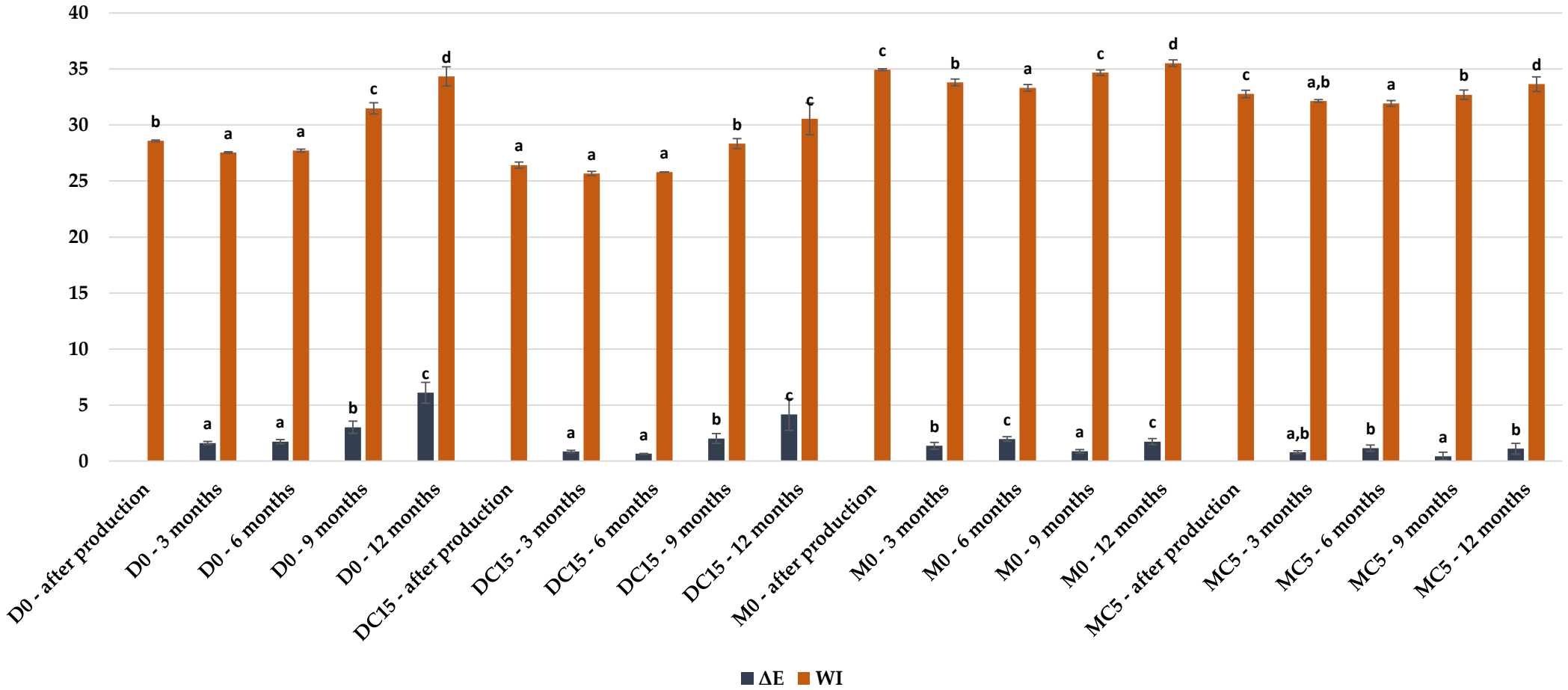
Materials and methods

- Dark and milk chocolates were produced in a ball mill. Four chocolates were produced, two with the addition of cocoa shell (5% in milk and 15% in dark) and two control chocolates without the addition.
- Total color change and whiteness index were calculated from parameters L*, a* and b* determined using chromameter.
- Total polyphenol content (TPC) was determined by Folin Ciocalteau method.
- Thermo-physical properties were determined by using differential scanning calorimetry
- Statistical analysis – least significant difference (LSD) test was used.

Chocolate composition

Sample	Sugar (%)	Cocoa mass (%)	Cocoa butter (%)	Milk powder (%)	Cocoa shell (%)	Lecithin (%)	Vanillin (%)
D0	42	36	21.57	-	-	0.4	0.03
DC15	42	21	21.57	-	15	0.4	0.03
M0	45	14.74	24.83	15	-	0.4	0.03
MC5	45	9.74	24.83	15	5	0.5	0.03

Results



*D0 – dark chocolate withouth added cocoa shell; M0 – milk chocolate withouth added cocoa shell; DC15 – dark chocolate with 15% of cocoa shell; MC5 – milk chocolate with 5% of cocoa shell; For each parameter and chocolate, means followed by the same letter are not significantly different ($P<0.05$)

Figure 1. Total color change (ΔE) and whiteness index (WI) of chocolates with and without added cocoa shell

Results

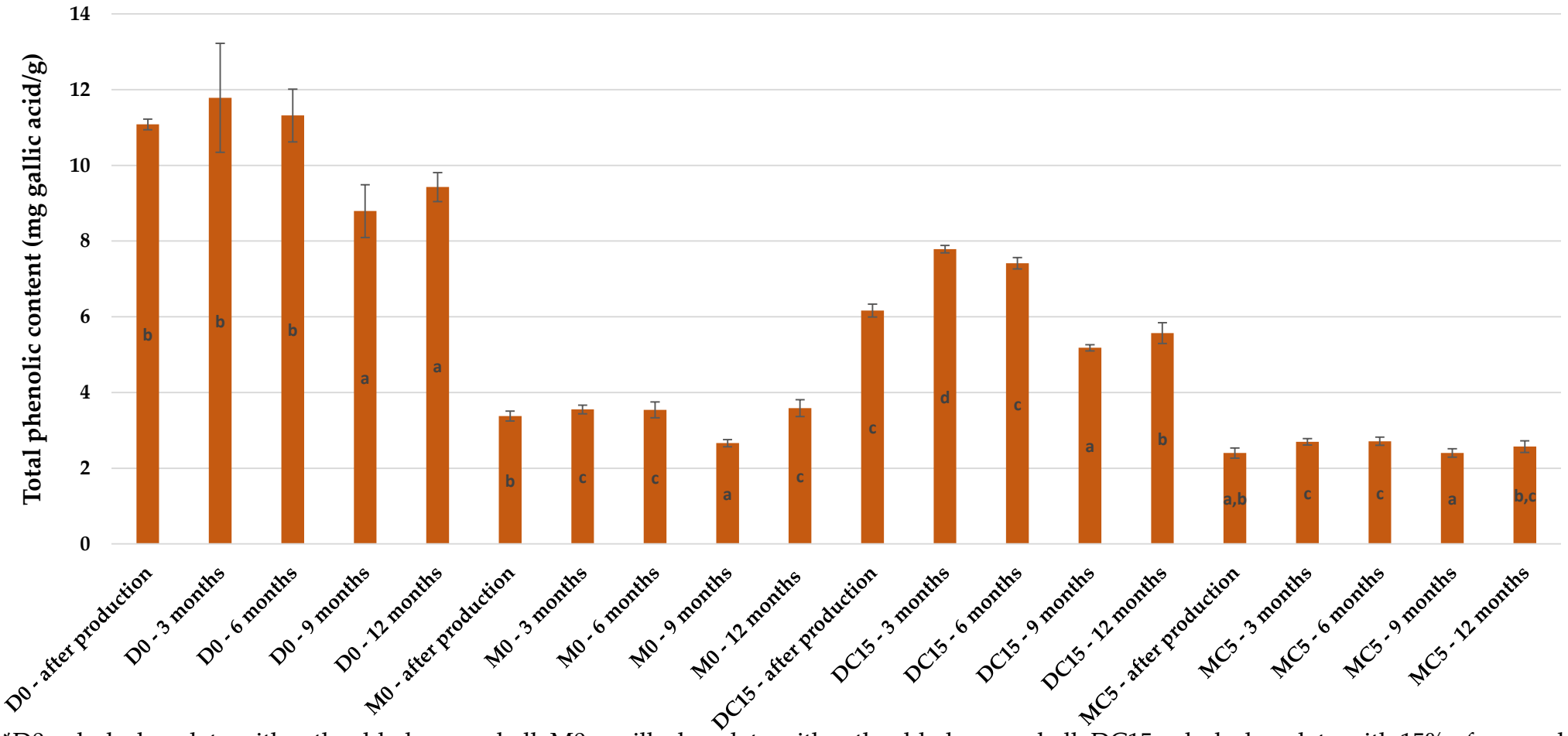


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Figure 2. Total phenolic content of chocolates with and without added cocoa shell

Results

Table 1. Melting parameters of chocolates without added cocoa shell

Sample	T_{onset} (°C)	T_{peak} (°C)	T_{endset} (°C)
D0 – after production	32.32 ± 0.00^{b}	32.45 ± 0.07^{a}	34.7 ± 1.25^{a}
D0 – 3 months	30.98 ± 0.34^{a}	33.18 ± 0.08^{a,b}	34.13 ± 0.10^{a}
D0 – 6 months	31.08 ± 0.18^{a}	34.25 ± 0.69^{b}	35.65 ± 1.04^{a}
D0 – 9 months	32.04 ± 0.37^{b}	34.84 ± 0.02^{b}	36.13 ± 0.09^{a}
D0 – 12 months	31.24 ± 0.21^{a,b}	34.62 ± 0.05^{b}	36.03 ± 0.01^{a}
M0 – after production	25.81 ± 0.31^{a}	31.78 ± 0.12^{a}	32.95 ± 0.27^{a}
M0 – 3 months	29.27 ± 0.00^{c,d}	33.35 ± 0.00^{b}	34.46 ± 0.00^{b}
M0 – 6 months	28.18 ± 0.03^{b}	33.36 ± 0.17^{b}	34.64 ± 0.06^{b}
M0 – 9 months	29.67 ± 0.10^{d}	33.65 ± 0.18^{b}	35.78 ± 0.23^{c}
M0 – 12 months	28.89 ± 0.23^{c}	33.32 ± 0.13^{b}	35.49 ± 0.16^{c}

*D0 – dark chocolate withouth added cocoa shell; M0 – milk chocolate withouth added cocoa shell; DC15 – dark chocolate with 15% of cocoa shell; MC5 – milk chocolate with 5% of cocoa shell; For each parameter and chocolate, means followed by the same letter are not significantly different ($P<0.05$)

Results

Table 1. Melting parameters of chocolates with added cocoa shell

Sample	T_{onset} (°C)	T_{peak} (°C)	T_{endset} (°C)
DC15 – after production	26.41 ± 0.05[a]	31.98 ± 0.01[a]	33.18 ± 0.05[a]
DC15 – 3 months	28.42 ± 0.05[b]	33.11 ± 0.00[b]	34.12 ± 0.00[b]
DC15 – 6 months	27.93 ± 0.50[b]	33.45 ± 0.43[b]	34.65 ± 0.09[c]
DC15 – 9 months	30.22 ± 0.16[c]	34.61 ± 0.04[c]	36.35 ± 0.19[e]
DC15 – 12 months	30.06 ± 0.02[c]	34.24 ± 0.05[c]	35.86 ± 0.05[d]
MC5 – after production	26.21 ± 0.03[a]	31.37 ± 0.03[a]	33.34 ± 0.13[a]
MC5 – 3 months	27.68 ± 0.00[b]	32.73 ± 0.00[b]	34.66 ± 0.00[b]
MC5 – 6 months	27.45 ± 0.05[b]	32.72 ± 0.00[b]	34.69 ± 0.05[b]
MC5 – 9 months	29.79 ± 0.05[d]	33.39 ± 0.14[c]	35.35 ± 0.21[c]
MC5 – 12 months	28.93 ± 0.45[c]	33.34 ± 0.21[c]	35.39 ± 0.08[c]

*D0 – dark chocolate withouth added cocoa shell; M0 – milk chocolate withouth added cocoa shell; DC15 – dark chocolate with 15% of cocoa shell; MC5 – milk chocolate with 5% of cocoa shell; For each parameter and chocolate, means followed by the same letter are not significantly different ($P<0.05$)

Conclusions

- Total color change and whiteness index were lower in chocolates with cocoa shell than in control samples. Over time, color change occurred less in chocolates with added cocoa shell.
- Total polyphenol content in all chocolates did not change significantly through the storage period, although chocolates with cocoa shell had lower TPC because the part of the cocoa liquor was replaced with cocoa shell.
- Over a period of one year, melting properties were not significantly effected by addition of cocoa shell in dark and milk chocolates.


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