Stability of microencapsulated n-3 cod liver oil

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Introduction

Epidemiological studies suggest that a diet high in polyunsaturated fatty acids such as those found in fish oil may have beneficial effects on human health. Polyunsaturated fats are, however, sensitive to oxidation. Microencapsulation has been used to protect oil from oxidation and convert it from liquid form to a powder, thus providing food manufacturers with new functional ingredients.

Materials and methods

Oxidation and the stability of microencapsulated polyunsaturated lipids (fish oil) was investigated with respect to the level of protection supplied by different coating mixtures. The fish oil was microencapsulated using a Büchi B-191 Mini Spray Dryer. Coating materials were mixtures containing a protein (caseinate) and different types of carbohydrates: lactose (CALA), sucrose (CASU) or maltodextrin (CAMD).

Measurements of oxygen uptake, volatile composition (SPME-HS-GC/FID and GC/MS), and sensory analysis were used to follow the oxidation of the encapsulated oil and the results compared to analysis of free fat, capsule diameter and ratio of vacuole containing capsules.

Results

As shown in figure 1, the caseinate+lactose (CALA) mixture showed greater oxidative stability than the caseinate+maltodextrin (CAMD) mixture. Even though the sucrose-containg capsules (CASU) began to deteriorate before the other samples, they did so more slowly. The ratio of capsules containing vacuoles (air bubbles) was significantly smaller in the lactose containing capsules ($p<0.05$) compared to both CASU and CAMD. Surprisingly, the CALA mixture resulted in significantly greater free fat (solvent extractable fat) compared to both CASU and CAMD mixtures ($p<0.05$), while there was no difference between CASU and CAMD. No significant difference was seen in mean capsule diameter ($p>0.05$) of the samples.

Conclusions

Difference in oxidative stability of cod liver oil microencapsulated with mixtures of caseinate and different types of carbohydrates could not be traced to difference in capsule size, but ratio of vacuole containing capsules may explain some of the difference. Greater amount of free fat on the surface of lactose-containing samples does not seem to influence oxidative stability compared to the other samples.

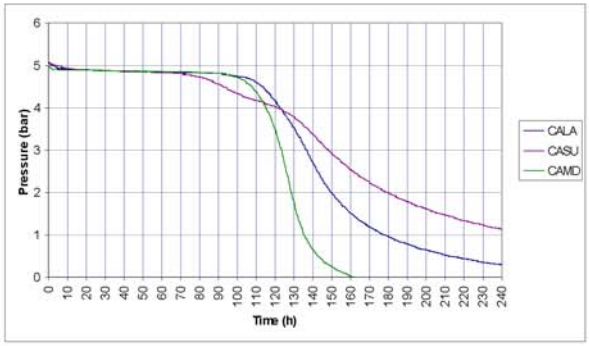

Figure 1: Oxypres results from the three microencapsulated cod liver oil samples.

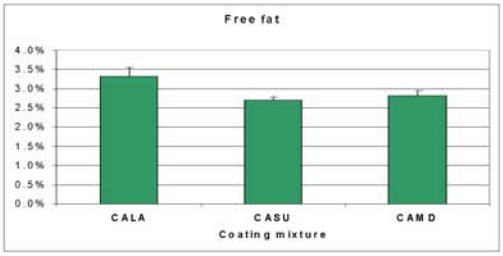

Figure 2: Free fat (solvent extractable fat from the surface of microcapsules).

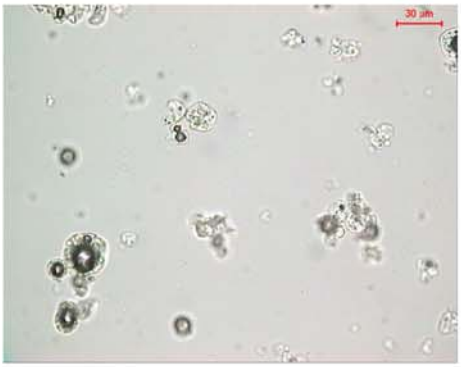

Figure 3: Spray-drying microencapsulated oil (sample: CALA). Vacuoles in the lower left corner of the image.

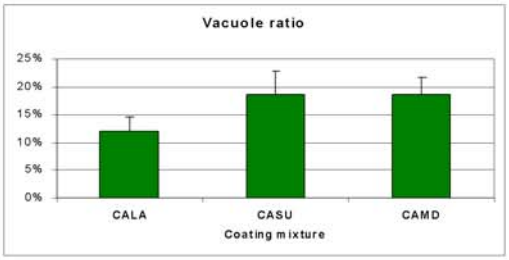

Figure 4: Vacuole ratio (% of capsules that contain air bubbles)

Table 1. Key aroma compounds identified by SPME, GC/O and GC/MS in fresh microencapsulated fish oil

Possible compound	rt (min)[a]	RI[a]	ID means[b]	Odor description	Odor intensity[c]		
					CALA-0	CAMD-0	CASU-0
1-butanol			1, 2, MS				
pentanal	2.7	237	1, 2, MS	caramel, vanilla	3.5	2.5	2.5
3-hydroxy-2-butanone	3.4	274	1, 2, MS	heavy, milk-like	3.0	3.0	2.0
hexanal	6.1	369	1, 2, MS	gras	2.0	2.0	
cis-4-heptenal	10.7	500	1, 2, MS	rancid, potato-like	4.5	4.3	4.0
heptanal	11.0	507	2, MS	rancid	2.8	3.3	4.0
1-octen-3-ol	14.0	579	1, 2	mushroom	3.0	3.0	2.8
2,4-heptadienal	14.8	598	MS			+	+
2,6-nonadienal	20.6	759	1.2	cucumber	4.0	4.0	4.0
2,4-decadienal	25.0	930	1, 2	rancid	3.5	4.0	3.0

[a]Calculated ethyl ester retention index on DB-5ms capillary column

[b]Identification means: MS, mass spectra; 1, authentic standards; 2, odor identification; 3, odor identification and RI references

[c]Odor intensity calculated as average of at least two samples, intensity scale from 0 (not present) to 5 (very strong)

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