Effect of Processing Conditions on the Oxidative Stability of Meadowfoam Press Oil

Sir:

Meadowfoam, *Limnanthes alba*, is a new seed oil crop grown in the Pacific Northwest of the United States that is experiencing increased market demand as a source of long-chain FA for use in cosmetics, lubricants, and other industrial products (1,2). Meadowfoam oil is currently produced by solvent extraction; however, there is growing interest in press oils for the specialty markets. Crude meadowfoam oil exhibits an exceptionally high oxidative stability as measured by the oxidative stability index (OSI; Ref. 3). A pilot-scale study (POS Pilot Plant Corp., Saskatoon, Saskatchewan, Canada) was conducted to characterize the influence of flake thickness and subsequent refining steps on the oxidative stability of meadowfoam press oil.

Meadowfoam seed was obtained from the Oregon Meadowfoam Growers Association. Whole seed was equilibrated with deionized water in sealed containers over a 12-h period to increase the moisture level from an average value of 9.7 to 12.4%. Moisture-equilibrated seeds were preheated in a 1000-W microwave oven (Toshiba Corp., Osaka, Japan) for 5 min and then held for 40 min in a 120°C laboratory oven (Thelco, Model 130; Precision Scientific, Chicago, IL) to ensure deactivation of the enzyme thioglucosidase and thereby prevent the degradation of glucolimnanthin.

Seeds were divided into 10-kg batches and flaked to an average thickness of 0.45 mm (thin) or 0.65 mm (thick) by a flaking roll (E.R. & F. Turner, Ipswich, United Kingdom). Flaked seeds were pressed at a feed rate of 5 kg/h and 70°C (Gusta Model 10 Lab Press; Gusta Manufacturing, Winnipeg, Manitoba, Canada). Crude press oils were collected and centrifuged to remove solids (Damon ITEC Model DPR-6000 Centrifuge; International Equipment Co., Needham Heights, MA) and degummed in 500-g batches in a 1-L round-bottomed glass vessel fitted with an overhead stirrrer and heating mantle. The oil was heated to 65°C with agitation and the addition of 2% (w/w) water. The mixture was heated and held at 90°C for 15 min. Precipitated material was separated by centrifugation. Degummed oil was refined by mixing with 16 Bé sodium hydroxide (Van Waters & Rogers, Saskatoon, Canada), at 2.8% (w/w) for 30 min. The oil was centrifuged to remove soapstock and washed with deionized water at 15% (w/w), 75°C, for 15 min. Bleaching was performed in a 500-mL filter flask using 2% (w/w) Tonsil Supreme 120 FF (Quimica Sumex, S.A. de C.V., Mexico City, Mexico) at 110°C for 30 min under vacuum. The oil was then cooled to 70°C and filtered through a bed of High Flow Filter Aid (Manville Corp., Denver, CO).

Determinations of FFA, moisture, PV, and color were performed after each processing step following the standard test methods of the American Oil Chemists' Society, i.e., Ca 5b-71, Ac 2-41, Cd 8-53, and Cc 13b-45, respectively (4). OSI determinations were made at 130°C on an oxidative stability instrument (Omnion, Inc., Rockland, MA) following a modification of AOCS method Cd 12b-92 (4). Air flow was set to 5.2 psig producing a velocity of 140 ± 8 mL/min. Samples were weighed to 5.00 ± 0.05 g and run in duplicate or until a relative standard deviation (RSD) of less than 2.0% was obtained. Conductivity probes were cleaned by the method of Akoh (5). After each analysis, the tubing and the borosilicate sample tube were replaced. OSI times were determined by the second derivative method (3).

Results obtained for crude meadowfoam press oils are presented in Table 1. The properties obtained for seeds flaked and pressed without moisture or temperature adjustments are also tabulated for comparison. Values of FFA, PV, and color were comparable for press oils obtained from thick and thin flakes of conditioned and unconditioned seeds. The yields for all these crude press oils were 16 ± 0.2%. Significantly, OSI values determined for press oil obtained from conditioned seeds were approximately 50% greater than those measured for press oil obtained from the unconditioned seed.

The oxidative stability of press oils obtained from conditioned seeds was determined after the oil was subjected to

TABLE 1
Properties of Crude Meadowfoam Press Oil Obtained from Flaked Seed

Flaked seed	FFA[a] (%)	PV[a] (meq/kg)	Lovibond (2.54 cm) (Y)	Lovibond (2.54 cm) (R)	OSI[a] (h)
Conditioned					
Thick	0.76	0.52	70	2.6	38.88
Thin	0.80	0.50	70	2.7	42.63
Unconditioned					
Thick	0.68	0.56	70	3.6	24.13
Thin	0.64	0.62	70	3.8	29.13

[a]Replicated values ≤5% relative standard deviation (RSD). OSI, oxidative stability index.

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TABLE 2
OSI[a] Values (h) for Fractions of Meadowfoam Press Oils from Conditioned Seeds

Flake size	Crude	Degummed	Refined	Bleached
Thick	38.88	28.38	21.25	20.75
Thin	42.63	30.75	21.75	20.75

[a]Replicated values ≤2% RSD. For abbreviations see Table 1.

laboratory degumming, refining, and bleaching operations. These data are presented in Table 2. Oil samples obtained from unconditioned seeds contained glucolimnanthin degradation compounds and were not considered for further analysis. As expected, the OSI values decreased steadily with additional processing of the crude press oils obtained from both thin and thick flakes. Oil expelled from thin flakes produced the highest OSI values; however, by the end of the bleaching step the OSI values were essentially equivalent for oil obtained from either thick or thin flakes. The greatest decreases in OSI values occurred following degumming and refining. This decline in OSI values is consistent with the removal of antioxidant components from the oil during processing. These data indicate that conditioning meadowfoam seed prior to flaking produces crude press oils with higher oxidative stability compared to unconditioned seeds, although flake thickness was not observed to affect the quality or the yield of oil in these experiments significantly.

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