

Original Article

Physicochemical and quality characteristics of cold-pressed flaxseed oils

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Abstract

Flaxseed oils currently sold on the worldwide market are not governed by specific standards or specifications. In this study, the physicochemical and quality characteristics of seven cold-pressed flaxseed oils sold in New Zealand have been analyzed. General regulations and specification for edible vegetable oils and cold-pressed oils were used as a guide. Fatty acid composition, tocopherol composition, moisture and volatile matter content, free fatty acids, chlorophyll pigments, total phenolic acids, total flavanoids, acid value, unsaponifiable matter, peroxide value, conjugated dienoic acids, *p*-anisidine value and specific extinction in the ultraviolet spectrum of the flaxseed oils were measured. Color and dielectric measurement of the flaxseed oils were also estimated using a spectrophotometer and a food oil sensor, respectively. The physicochemical characteristics of the flaxseed oils were found to be quite similar with only a few significant variations. Four out of the seven flaxseed oils passed all the quality tests conducted in this study.

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1. Introduction

Flax (*Linum usitatissimum*) is an economically important oilseed crop (Oomah, 2001; Lei et al., 2003) containing about 40% oil in the seed. Flaxseed (also known as linseed) is regaining its popularity from its traditional usage as a raw material in oil production because of the reported health benefits of *n*-3 fatty acids and its exceptionally high content of the *n*-3 fatty acid, alpha linolenic acid (ALA). According to Daun et al. (2003), flaxseed oil usually contains greater than 50% of ALA. Supplements containing flaxseed oil, mostly in gelatin capsules, are being sold in health food stores and marketed over the Internet. Cold-pressed flaxseed oil is also commercially available in low- and high-lignan forms in the North American market (Morris and Vaisey-Genser, 2003). Consuming flaxseed oil is one good way to increase the *n*-3 fatty acids in the diet as most societies nowadays are known to generally consume plenty of *n*-6 fatty acids in processed foods, margarine and vegetable oils and the absolute amounts of *n*-3 fatty acids in the diet are too low. With regard to *n*-3 fatty acids

dietary recommendations, Deckere et al. (1998) reported that an intake of 2 g/day or 1% of energy of ALA appears prudent whereas Simopoulos et al. (2000) reported 0.65 g/day of docosahexaenoic acid (DHA) plus eicosa-pentaenoic acid (EPA), and 2.22 g/day of ALA as the adequate intake (AI) for adults. The AI is a value based on experimentally derived intake levels or approximations of observed mean nutrient intakes by a group (or groups) of healthy people and this reference intake is used instead of recommended dietary allowance if sufficient scientific evidence is not available to calculate an estimated average requirement (Simopoulos et al., 2000).

The high content of ALA in flaxseed oil is, however, highly susceptible to oxidation, leading to rapid deterioration of quality. Lukaszewicz et al. (2004) reported that even after cold extraction, to avoid rapid appearance of rancidity, flaxseed oil is often supplemented with vitamin E, stored in dark glass jars and may not be used for frying.

There is one standard that applies to conventional linseed oil, American Society for Testing and Materials (ASTM) D 234-82 (1998), which covers the properties of raw linseed oil and the applicable test method (Kolodziejczyk and Fedec, 1995). The International Organization for Standardization (ISO) 5513-1982 “Linseed for the Manufacture of Oil”

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Specification, which specifies flaxseed requirements for the manufacture of oil for industrial use including foodstuffs was withdrawn on 18 November 1994. As there is no specific standard or specification available for the use of flaxseed oil in the food sector, standard qualities and compositions of other unrefined, edible vegetable oils were used as a guide. Among the standards used were Codex Alimentarius Commission (1999) standard for virgin oils and cold-pressed fats and oils, New Zealand Food Regulation (1984) specification for edible and virgin fats and oils, and Australia New Zealand Food Authority (2000) for edible oils. The objective of this research was to analyze the physicochemical and quality characteristics of cold-pressed flaxseed oils sold in New Zealand. Seven cold-pressed flaxseed oils were available at the market at the time of study and therefore were analyzed.

2. Materials and methods

2.1. Materials

Details of the seven cold-pressed flaxseed oils used are given in Table 1. Basic quality parameters of the seeds used

in preparing the oils are to be free from pests, ergot, poisonous seeds, mycotoxins, mould, mites and any bacterial-related diseases. The minimum oil content of the seed is 36%. Desirable moisture content and acid value of the seed are below 8% and 2%, respectively. All the chemicals and solvents used were of analytical or HPLC grade.

2.2. Methods

2.2.1. Fatty acid composition

Fatty acid composition was determined using gas chromatography of fatty acid methyl esters (FAME). FAME were prepared according to the method of van-Wijngaarden (1967) with some modifications. Approximately, 20 mg of sample was weighed into a glass tube (15.0 cm × 1.3 cm with Teflon-lined screw cap) and 2 mL of 0.5 N methanolic sodium hydroxide was added. The mixture was boiled for 20 min and then cooled to room temperature. About 2 mL of diethyl ether and 5 mL of water were added and mixed well by tilting the capped tube with no shaking of the tube. The ether layer was then discarded and the aqueous layer was acidified with

Table 1
The names of the flaxseed oils, together with their source, bottle volume, relative cost and remarks on their bottle labels

Flaxseed oil	Abbreviated name	Source	Bottle volume	Cost/mL (cents) ^a	Organic certification	Remarks on label	Storage instruction
Waihi Bush organic farm flaxseed oil	WB	South Canterbury	250 mL	5	Yes	Not for cooking	Once opened, keep refrigerated. Once opened use within 5 weeks. Can be frozen.
Melrose organic flaxseed oil	MEL	Bottled in Australia from imported flaxseed oil	500 mL 250 mL	8	Yes	Do not heat	Store under refrigeration. Use within 8 weeks of opening. May be frozen with confidence.
Oil seed extractions limited flaxseed oil	OSEL	Canterbury Plains	500 mL ^b	—	None	—	If stored in unopened containers at under 20 °C, this product can be expected to have a shelf life of 12 months.
Oil seed extractions limited organic flaxseed Oil	OSELO	Canterbury Plains	^b	—	Yes	—	
Good health FlaxOmega™ extra virgin high lignan flax oil	FO	Canterbury Plains	250 mL	6	Yes	Not suitable for heating	Keep refrigerated and use within 3 months of opening. Can be frozen.
Essential body nutrition flaxseed oil	EBN	Canterbury Plains	250 mL	4	None	Not suitable for cooking	Best kept refrigerated.
Healtheries flaxseed oil	HEA	Packed in New Zealand from imported flaxseed oil	500 mL 500 mL	4	None	Not suitable for heating	Store below 30 °C.

^aCost was calculated based on 500-mL price.

^bOil seed extractions limited supply flaxseed oil in bulk.

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