

Fatty acid, tocopherol and phytosterol composition of cucurbit seeds grown in Marlborough, New Zealand.



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INTRODUCTION

Cucurbits are a group of plants that can grow well with irrigation in hot dry conditions. In New Zealand cucurbits are grown mostly for their edible flesh, however in other countries they are prized for their tasty oil containing seeds.

Edible seeds harvested from cucurbits have a large range of uses, from either being consumed directly or as a filler in soups. The extracted seed oil can be used as a cooking or salad oil or as a condiment in foods.

Recent research has shown that the composition of the oil extracted from cucurbit seeds contains a wide range of nutrients and fatty acids. A few reports have reported that the extracted seed oil contains high but variable phytosterol and antioxidant contents.

It is possible that the nutritional content of these interesting seed oils is affected by cultivar type and its interaction with environmental effects. It is also possible that the post harvesting processing of the seeds and the oils may affect the nutrient composition.

METHODS

Cucurbit seeds provided by Bay Oils were grown in the 2001/2 season in Marlborough New Zealand. Investigative analysis was carried out on five different cultivars of the *Cucurbita maxima* variety, as well as a single cultivar of *C. pepo*. The six different cultivars were analysed for their proximate composition. In addition the oil was extracted and analysed for the content of vitamin E, sterols and fatty acid composition.

RESULTS AND DISCUSSION

Proximate analysis

The proximate chemical analysis of the six seed lines is reported in Table 1. The nutrient compositions of all the seeds were very similar and values compared well to literature values.

Table 1: Proximate analysis of pumpkin seeds (% fresh weight).

Seed	Dry matter	Ash	Organic matter	Crude Protein	Fat	Total Carbohydrates ¹
<i>C. maxima -A</i>	94.4	2.7	97.3	4.5	37.9	49.2
<i>C. maxima -B</i>	94.1	3.7	96.3	5.0	33.8	51.5
<i>C. maxima -C</i>	93.8	3.1	96.9	4.8	35.0	50.9
<i>C. maxima -D</i>	93.8	3.1	96.9	4.8	34.4	51.5
<i>C. maxima -E</i>	93.6	3.0	97.0	4.0	23.1	63.5
<i>C. pepo</i>	95.9	3.9	96.1	5.5	44.4	42.1

¹ = Total carbohydrates by difference

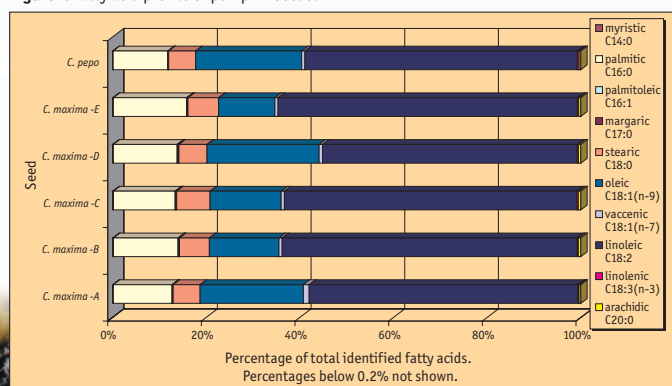
Fatty Acids

The major fatty acids found in the cucurbit seeds are shown in Figure 1. Linoleic acid was the major fatty acid ranging from 54 to 64% of the total. The major fatty acid profile varied between the different lines and varieties, and was different to values reported for similar cultivars grown in other countries.

Previous research has shown linoleic acid to range from 39-77% and oleic acid from 10-32%. There has also been a report of the predominance of oleic acid, 53.5%, over linoleic acid, 18.8%.

The difference in fatty acid content may be due to varietal differences and environmental factors may have an influence as well.

Figure 1. Fatty acid profile of pumpkin seeds.



Vitamin E

Table 2 shows the results of the α and γ tocopherols, identified in the seeds sampled. No tocotrienols were observed. Previous research has identified three of the five tocopherols and two of the four tocotrienols in pumpkin seeds.

The levels of vitamin E in the oil varied considerably between the different lines and varieties, ranging from 2.0 to 64.4 mg/kg and from 13.0 to 117.8 mg/kg dry weight of seed, for α and γ tocopherol respectively. All the cucurbits contained high levels.

Table 2: Vitamin E content of pumpkin seeds (mg/kg seed)

Seed	α - Tocopherol	γ - Tocopherol	Total Tocopherol	Ratio (γ/α)
<i>C. maxima -A</i>	10.4	117.8	128.1	11.4
<i>C. maxima -B</i>	1.6	27.1	28.7	17.0
<i>C. maxima -C</i>	20.1	110.7	130.7	5.5
<i>C. maxima -D</i>	4.0	56.0	60.0	14.1
<i>C. maxima -E</i>	2.0	13.6	15.5	7.2
<i>C. pepo</i>	64.4	93.4	157.8	1.4

Sterols

All the cucurbits contained high levels of phytosterols, many of which are not commonly found in other seed oils. The sterol composition consisted mainly of $\Delta 7$ -sterols with some $\Delta 5$ -sterols (Table 3), comprising between 56 to 64% of total unsaponifiables. Notably, between 34.6% and 44.1% of the unsaponifiables were unidentified.

Table 3: Sterol composition of pumpkin seed lipids

Seed	Percent of total sterol fraction					
	<i>C. maxima -A</i>	<i>C. maxima -B</i>	<i>C. maxima -C</i>	<i>C. maxima -D</i>	<i>C. maxima -E</i>	<i>C. pepo</i>
Cholesterol	0.6	0.6	0.7	0.9	0.8	1.0
Campesterol	3.2	2.2	2.2	3.1	2.9	2.2
Stigmasterol	4.2	2.1	2.1	3.4	3.8	1.9
α -Spinasterol ¹	23.4	19.6	19.6	29.1	19.2	21.1
$\Delta 5$ -Avenasterol	3.9	3.4	3.4	3.1	5.1	2.2
Sitosterol	2.8	2.2	2.2	1.9	3.0	2.4
$\Delta 7$ -Avenasterol	7.7	7.5	7.5	7.8	10.2	10.2
$\Delta 7$ -Stigmasterol	4.4	5.0	5.0	3.5	6.2	4.2
Stigmasta-7,						
25-dien-3 β -ol	12.2	13.2	13.2	11.5	14.4	13.5
Other ²	37.6	44.1	44.1	35.6	34.6	39.2

¹ Also contains some Stigmasta-7, 22, 25-trien-3 β -ol

² Unidentified sterols and other unsaponifiables

Conclusions

The results indicate that the composition of the seeds of New Zealand grown cucurbits contain similar proximate composition to plants grown elsewhere in the world. It is clear, however, that the composition of the fatty acids, sterols and vitamin E are quite different to plants grown elsewhere. This could present considerable advantages when oils of different attributes are being requested for a range of end uses.

Further research is proceeding to optimise variety selection and the effect of environment on the fatty acid, tocopherol and phytosterol composition of this seed oil. This will help to identify the most useful functional properties of this interesting plant seed oil.

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