TOTAL FAT CONTENT AND FATTY ACID PROFILE OF PSEUDOCEREALS

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INTRODUCTION

Amaranth, quinoa, and buckwheat are dicotyledonous plants that have starch-rich seeds (**Figure 1**) similar to those from cereals and that are classified as pseudocereals. Amaranth and quinoa belong to the genera *Amaranthus* and *Chenopodium, respectively,* which belong together in the family *Amaranthaceae*, whereas buckwheat (*Fagopyrum*) belongs in the *Polygonaceae* family [1]. Recently, pseudocereals have gained more popularity thanks to their chemical composition as source of protein, B group vitamins and minerals, and for their gluten free flour [2]. Moreover, it has been reported that some pseudocereals can present a fat content higher than the one for cereals [3,4]. The aim of this work was to evaluate the fatty acid profile of various comercial samples of pseudocereals, namely amaranth, buckwheat, and three varieties of quinoa.

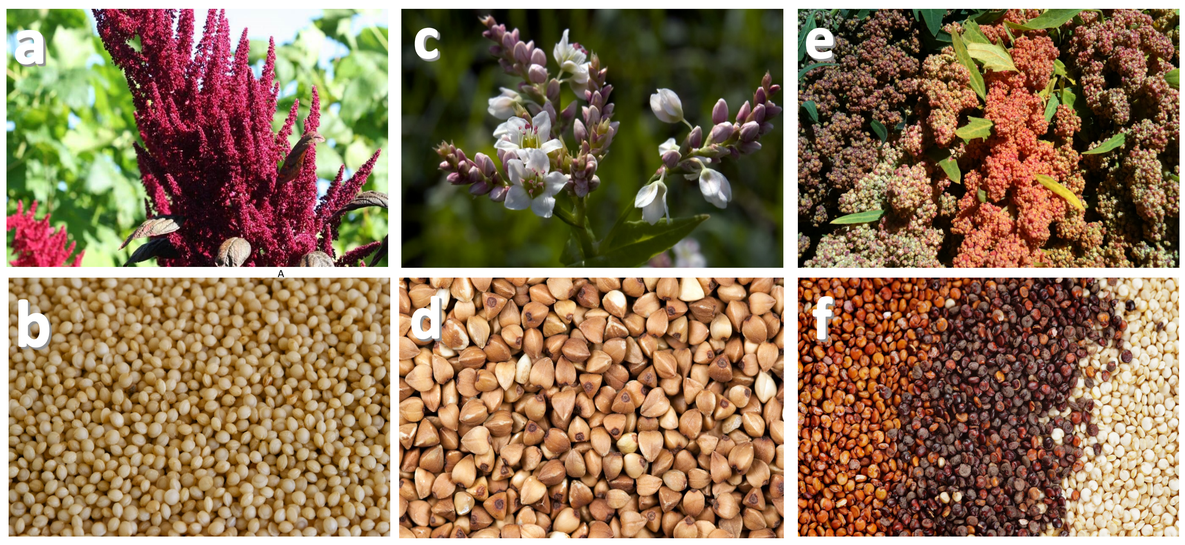

Figure 1 – Amaranth (**a** and **b**) , buckwheat (**c** and **d**), and quinoa (**e** and **f**) plants and seeds, respectively.

METHODS

Moisture and ash contents were determined by gravimetry, while total fat content was obtained using Soxhlet extraction apparatus and subsequent quantification by gravimetry. The fatty acid profile of the fat extracts was evaluated by gas chromatography with flame ionization detector (GC-FID) using the following conditions: column type OPTIMA 225, lenght 25m, internal diameter 0.32mm; injector temp. 250℃, oven temp. 50-220℃, detector temp. 260℃; detector pressure 0.91bar. Data was processed using Clarity 'Data apex' (version 4.0.1.700) software.

RESULTS

➢ Moisture, ash, and total fat contents

Table 1 - Chemical composition of amaranth, quinoa (black, red, and real varieties), and buckwheat. (mean ± SD, n=3)

	Amaranth	Black quinoa	Red quinoa	Real quinoa	Buckwheat
Moisture	8.91 ± 0.08	12.43 ± 0.08	10.48 ± 0.08	9.55 ± 0.06	12.72 ± 0.04
Ash (%, d.m.)	2.36 ± 0.02	3.00 ± 0.04	2.60 ± 0.08	2.54 ± 0.01	2.06 ± 0.01
Total fat	6.24 ± 0.01	8.00 ± 0.3	7.56 ± 0.04	7.74 ± 0.02	3.11 ± 0.04

- **Amaranth** and **quinoa varieties** exhibited the highest ash contents (2.36% and 2.54-3.00%, respectively), while **buckwheat** showed the lowest with 2.06%;
- **Buckwheat** showed the lowest total fat content (3.11%), while **amaranth** and **quinoa** (6.24% and 7.56-8.00%, respectively) presented total fat contents three times higher than those frequently reported for cereals.

➢ Fatty acid profile

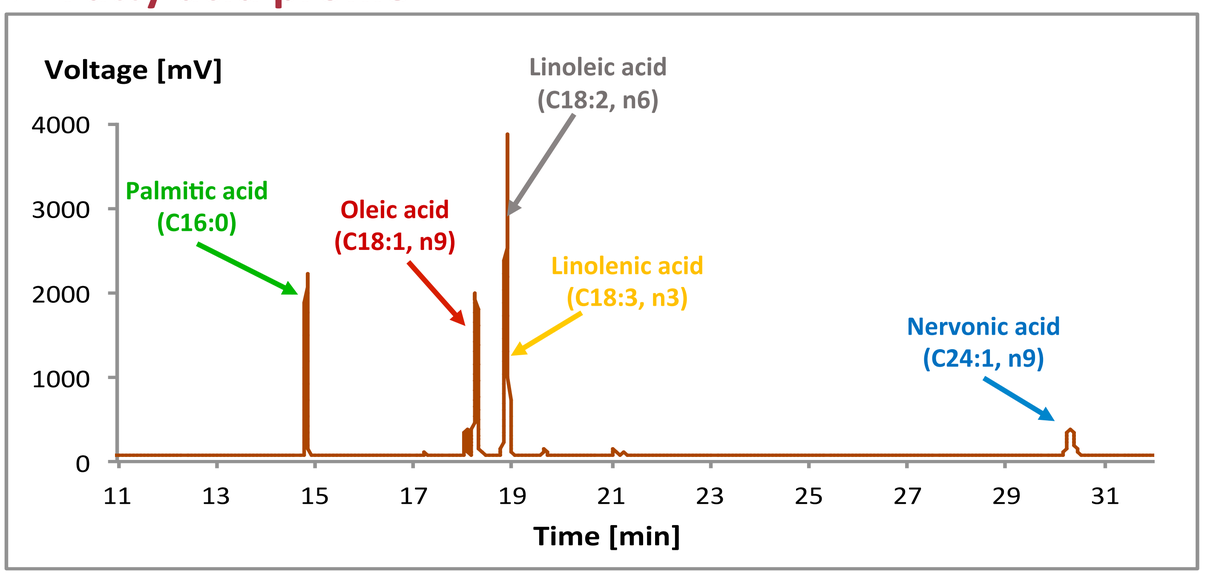

Figure 2 – GC-FID chromatogram evidencing the fatty acid profile of amaranth.

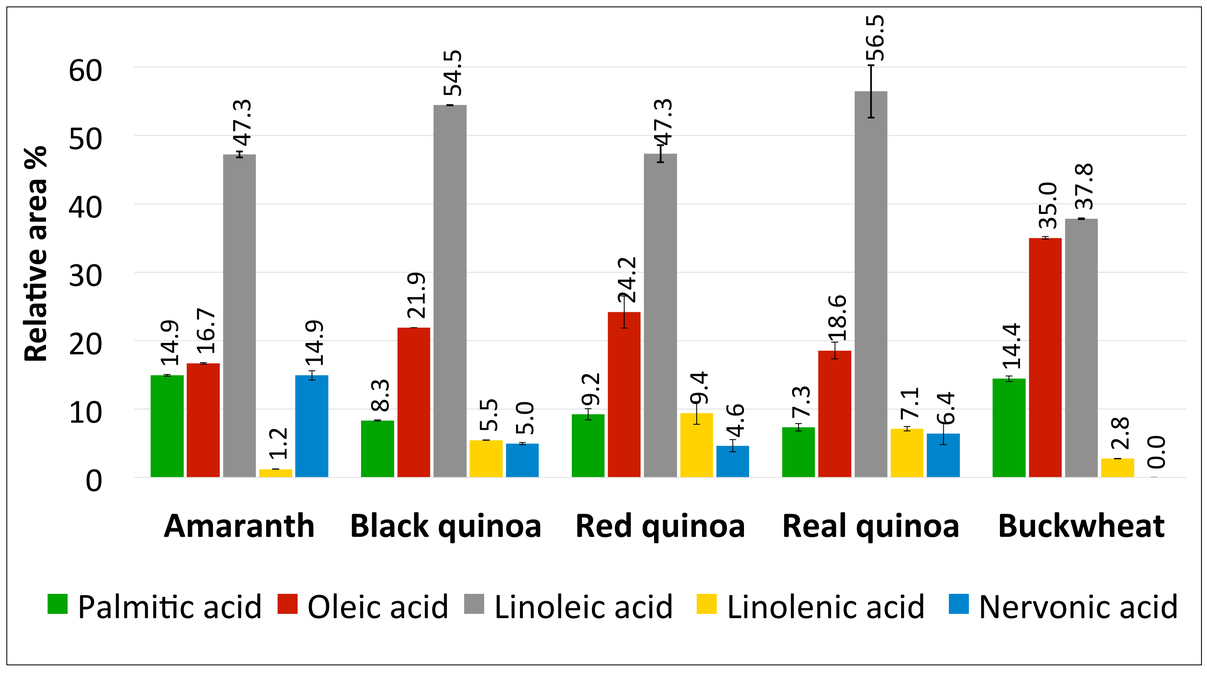

Figure 3 – Amaranth, quinoa (black, red, and real varieties), and buckwheat fatty acid profiles, expressed as relative area percentage (mean ± SD, n=2).

- Palmitic, oleic, linoleic, linolenic, and nervonic acids were the most abundant fatty acids, comprising at least 90% of the total fatty acids detected in the pseudocereal samples;
- **Amaranth** and **quinoa varieties** presented a similar fatty acid profile, with linoleic acid (ω-6 essential fatty acid) as the most abundant fatty acid (47.3-56.5%) followed by oleic acid, detected in lower proportions (16.7-24.2%); Minor proportions of nervonic acid, which is only detected in vestigial amounts in some cereals and is frequently associated with the enhancement of brain function and the prevention of demyelination, were also detected;
- **Buckwheat** presented a distinct fatty acid profile comprising similar proportions of linoleic and oleic acids (37.8 and 35.0%, respectively);

- **Unsaturated fatty acids** were the most abundant for all the pseudocereals analyzed, accounting for more than 75% of the total fatty acids detected in the pseudocereal samples;
- From these, more than 50% corresponded to **polyunsaturated fatty acids** (mainly linoleic acid)

CONCLUSIONS

- Pseudocereals exhibited total fat contents higher than those usually reported for cereals, with significant proportions of polyunsaturated fatty acids, such as linoleic and linolenic acids, making them valuable sources of essential fatty acids
- Amaranth and quinoa varieties appear as an interesting source of nervonic acid, which plays an important role in enhancing brain functions and preventing demyelination
- Amaranth and quinoa varieties, which belong to the family *Amaranthaceae*, presented a similar fatty acid profile, whereas buckwheat from the *Polygonaceae* family presented a different one, suggesting that this characteristic might be determined by the pseudocereal botanic origin

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