Oxidative stability of Chia seeds grown in Basilicata (Southern Italy)

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Introduction

Many studies have demonstrated that an increased intake of saturated lipids and trans-fatty acids is closely related to the incidence of cardiovascular disease, whereas the consumption of lipids rich in ω-3 fatty acids reduces the risk of this pathology [1]. Chia (*Salvia hispanica* L.) seed is among the richest natural source of α-linolenic acid (C18:3) which nutritionally represents the most important source of ω-3 [2]. Chia is a food crop originating from central America, important in the diet of pre-Columbian civilizations and the use of Chia seeds as a novel food ingredient has been approved by the European Parliament and the European Council [3]. Currently chia is not cultivated in Europe. The University of Basilicata in the last years has undertaken some studies with the aim to evaluate the possibility to cultivate chia plants and seed in Southern Italy. The genotype native to South America was grown under different agronomic conditions. cultivation density and with and without controlled irrigation. The oxidative stability of the seeds, were evaluated and compared. Moreover, an accelerated Shelf-life test was performed on some samples.

Materials and Methods

Chia seeds, genotype G8 [4], were grown in Basilicata, Southern Italy (field location: Lat. N 40°51'37,59" Lon. E 15°38'49,43") during June – December 2014 in two different conditions of sowing density and two different conditions of irrigation.

The oxidative stability of seeds was evaluated by the Oxitest method (T= 90°C, P(O_2)=6 bar), that works directly on the whole seed without preliminary fat separation. Each accelerated oxidation test was repeated three times using two different reactors (Fig. 1). An accelerated Shelf-life test was performed on some samples by Oxitest (run at 80, 90 and 100 °C) and elaborating the data by OXISoft™. Results from accelerated analysis were compared with traditional shelf life tests during 10 months storage.

The OXITEST response is the Induction Period (IP) expressed as the time required to reach an end point of oxidation corresponding to either a level of detectable rancidity or a sudden change in the rate of oxidation. Throughout the analysis the OXISoft™ software creates an oxidation curve and obtains the resulting IP value in real time (Fig. 2).

10 g of milled seeds were distributed on a sample holder, in each reaction chamber

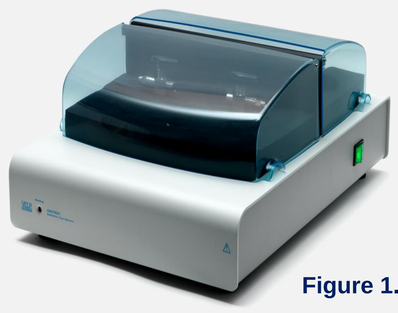

Figure 1. OXITEST

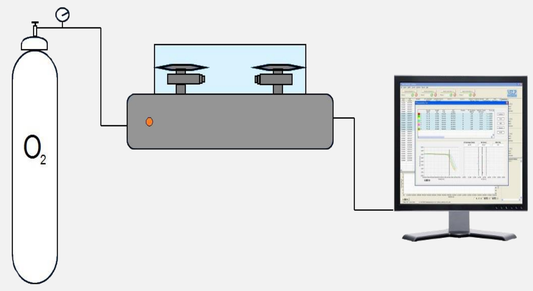

Figure 2. Oxitest operating system

Results and Discussion

Crop optimization

Sowing density: Density 1: 40 plants/m2
Density 2: 13 plants/m2
Irrigation: Irrigated: drip irrigation system (at 100% of evapotranspiration)
Not irrigated: natural rain water only

Chia seeds grown in 2014 in Southern Italy at different crop conditions

BaD1I	BaD1NI	BaD2I	BaD2NI
Density 1	Density 1	Density 2	Density 2
Irrigated	Not irrigated	Irrigated	Not irrigated

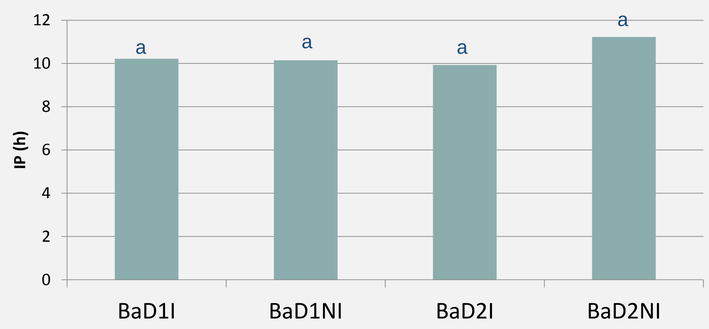

Fig. 3. Average of IP values of seeds cultivated in different conditions.

Statistically significant differences between samples are indicated with different letters (post hoc test at level of significance of 95%).

By Oxitest it has been possible to test the the oxidation stability of the 4 seed samples grown at different crop conditions. Each oxidation test was repeated 3 times.

There are no significant difference between IPs average values. This means that the crop conditions don't influence the initial oxidation stability of chia seeds.

Shelf life

Due to their high sensibility to oxidation, a crucial point of chia seed production is the definition of their shelf life. Accelerated and traditional shelf life test performed on sample BaD1I.

ACCELERATED METHOD: Estimated shelf life method by Oxitest:

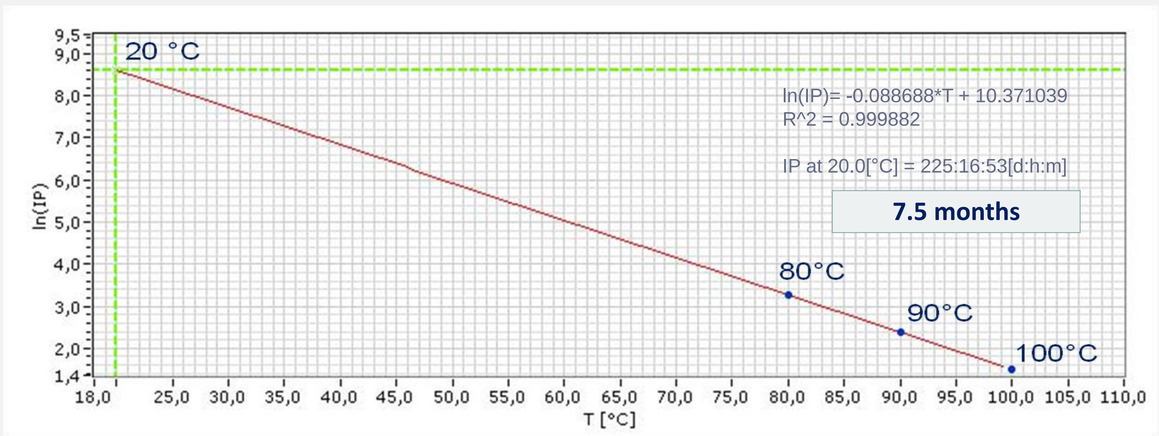

Fig. 4. Accelerated shelf life test obtained by the software OXISoft™.

TRADITIONAL METHODS: Peroxide and Acidity analyses on the extracted oil, during 10 months storage

Storage conditions:
- In a closed glass bottle
- climatic chamber at 20 °C
- absence of light

T0	at harvest time
T1	5 months storage
T2	10 months storage

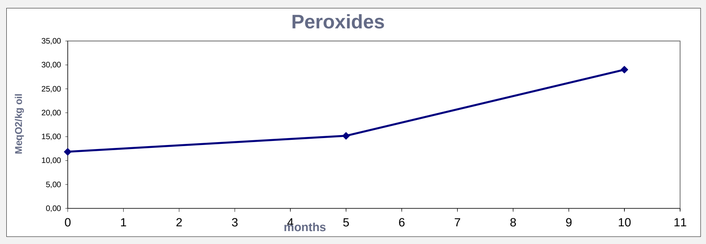

Fig. 5. Peroxide values of oil extracted from chia seed BaD1I, during storage.

There is an increase in the Peroxide Value PV after 5 months storage.

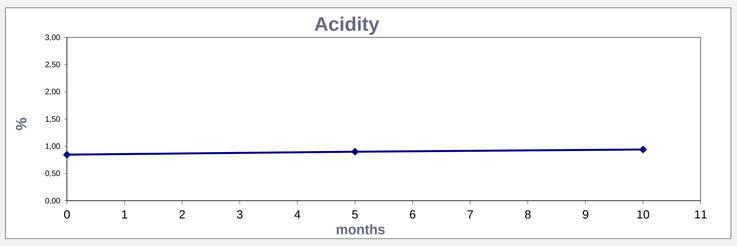

Fig. 6. Acidity values of oil extracted from chia seed BaD1I, during storage.

The acidity remains stable at low values (below 1 %) and therefore is not relevant for the definition of the Shelf Life.

Conclusions

Southern Italy can be considered a promising temperate climate zone for the production of Chia seeds.

Crop conditions don't affect the oxidation stability of chia seeds.

Results obtained from the Oxitest and Peroxides test on Southern Italy chia seeds are comparable, therefore accelerated and traditional shelf life methods are equivalent for chia seeds, whose shelf life is strictry correlated to oxidation stability.

The Oxitest is a useful tool for investigating the oxidation stability on the whole sample, with no need for preliminary fat separation.

References

[1] Zhao G., Etherton T.D., Martin K.R., West S.G., Gillies P.J., Kris-Eteron P.M. (2004) J. Nutr. 134, 2991-2997.
[2] Ayerza R. (2009) J. Oleo Sci. 58(7), 347-354.
[3] Commission EU (2009) Authorizing the placing on the market of Chia seed (*Salvia hispanica*) as novel food ingredient under Regulation (EC) No 258/97 of European Parliament of the Council. Official Journal of the European Union C:7645.
[4] G8 genotype is a long-day flowering genotype developed by the University of Kentucky and obtained through an agreement between the University of Kentucky and the University of Basilicata.