Omega-3 and omega-6 fatty acids from sustainable crops

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INTRODUCTION

Fats are essential for living organisms, having not only energetic but also structural and metabolic functions. They are constituents of cell membranes and tissues, and precursors of some hormones. The main structural components of fats are fatty acids (Yaqoob, 2013)√. Among these, polyunsaturated fatty acids (PUFAs) are fat components of great interest, as they have many beneficial effects on health, allowing to preserve cellular and metabolic balance. PUFAs include **omega-3** and **omega-6 essential fatty acids** such as **docosahexanoic (DHA), eicosapentanoic (EPA), and arachidonic (AA) acids,** along with their precursors **linoleic** and **α-linolenic acids**. They cannot be synthesized by the human organism and, therefore, must be taken with the diet. A balanced intake of omega-3 and omega-6 fatty acids can protect against cardiovascular and inflammatory diseases. Linoleic acid, precursor of omega-6 fatty acids, is the most abundant polyunsaturated fatty acid in nature. It is present in many seed oils and cereal grains (e.g. sunflower, sesame, peanut, corn oil, walnuts, almonds, wheat germ, rice, barley) (Saini and Keum, 2018)√. The primary sources of α-linolenic acid, precursor of omega-3 fatty acids, are instead mainly fish, fish liver oil, molluscs and crustaceans; it is present also in flax and soybean seed oil and in algae (Hossain, 2011)√. Due to poor sustainability of both fishing and conventional agriculture, it would be essential to have alternative sustainable sources of these essential acids (Maurer et al., 2012)√. The present work aimed at studying the suitability of different genotypes of some alternative crops: ***Cynara cardunculus var. scolymus* L. (artichoke), *Cannabis sativa* L. (hemp) and *Carthamus tinctorius* L.** (**safflower**) to be exploited as sustainable source of omega-3 and omega-6 fatty acids. These crops have been chosen because they have optimal agronomic features such as high tolerance to abiotic (drought, cold, salinity) and biotic stress (pathogens). They can be grown effectively at different climates and are also characterized by high land use efficiency, and low demand for nutrients**.**

FATTY ACIDS PROFILE ANALYSIS AND OIL YIELD DETERMINATION HAVE BEEN APPLIED TO SEED SAMPLES TO CHARACTERIZE AND VALORIZE THESE SUSTAINABLE AND ALTERNATIVE CROPS.

MATERIALS

- ✓ Artichoke selected genotypes from spring germplsm collection at ARSIAL Demonstrative Farm of Cerveteri, (Rome, Italy).
- ✓ Seeds of safflower from ENEA breeding programs.
- ✓ Hemp commercial varieties and commercial variety Futura 75 (from South Hemp Tecno, Taranto–Italy) .

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METHODS

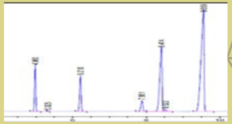
- ✓ Fatty acids extracted and derivatized into fatty acid methyl esters following a hydrolysis and methylation procedure, according to (Phippen et al., 2006)√; .
- ✓ GC analytical method parameters: capillary column Omegawax® (30 m, 0.25 mm i. d., 0.25 μm film thickness); 1' at 170°C to 225°C at 1°C/min; detector at 250°C; 1 μl injection volume.
- ✓ Hot (N–Esan) Solvent Randall Oil Extraction.

EXPERIMENTAL PLAN

Freeze-dried and powdered seeds

✓ FATTY ACIDS EXTRACTION AND ANALYSIS

Gas Chromatographic System (Agilent GC 7890 Series)



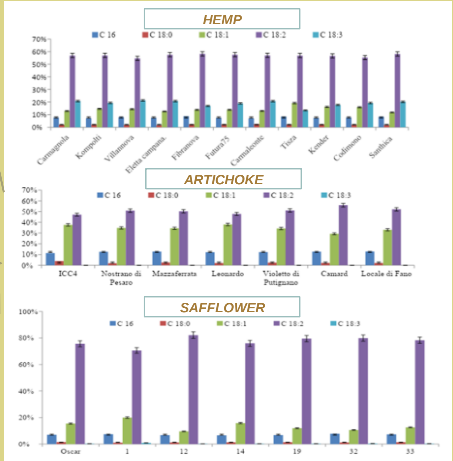
Fatty acids profile.
1 Palmitic acid (C16:0); 2. Stearic acid (C18:0); 3. Oleic acid (C18:1); 4. Linoleic acid (C18:2); 5. Linolenic acid (C18:3)

✓ OIL EXTRACTION AND YIELD EVALUATION

Randall extraction (VELP SCIENTIFICA™ SER148 Series Semi-Automatic Solvent Extractor)

Oil yield evaluation

RESULTS AND DISCUSSIONS



- ✓ Significant differences in the chromatographic fatty acids profile among the three different species analysed, but not between different genotypes of a same species;
- ✓ Linoleic acid (C18:2) is the most representative for all the three crops, with the highest percentages in safflower;
- ✓ **α**-linolenic acid (C18:3): Highest percentages in hemp; not detected in artichoke and only in traces in safflower;
- ✓ Oil yield: ~28-30% hemp, ~21-22%artichoke, ~28-29% safflower .

CONCLUSIONS

- ✓ The percentage composition of fatty acids of the analysed crops is in line with literature data, confirming a good content of omega-3 and/or omega-6 precursors;
- ✓ Hemp shows the most complete and balanced fatty acids profile and also a good value of oil yield. Therefore, it could be better able to meet the needs of sustainable development from a bioeconomy perspective.