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FLAX SEED OIL CHARACTERISTICS AS AFFECTED BY STRUCTURING OR BY ADDITION OF DRIED *SATUREJA HORTENSIS* L.

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Abstract: This paper presents a preliminary study focusing on flax seed oil characteristics as affected by structuring or by addition of dried *Satureja hortensis* L. Flax seed oil, summer savory enriched flax seed oil and flax seed oil oleogel were included in a short storage test at room temperature, peroxide values being monitored. The spreadability of the flax seed oleogel as compared to a standard commercial available breakfast spread was performed in order to assess the feasibility of a new potential product based on gelled flax seed oil. This preliminary study shows that both methods used proved an increased stability, further extensive studies being design in our lab for structuring optimization and demonstrating their mechanisms of action.
Keywords: flax seed oil, *Satureja hortensis* L., spreadability, texture analysis**.**

Introduction

Summer savory (*Satureja hortensis* L.) is an aromatic herb belonging to *Lamiaceae* family, well known for its medicinal properties (Hassanzadeh *et al.*, 2016). Carvacrol and thymol were reported as the main constituents of *Satureja hortensis* L. essential oil, among α-thujune, α-pinene, β-myrcene, β-terpinene, linalool, and β-caryophyllene (Fathi *et al.*, 2013; Hassanzadeh *et al.*, 2016). Dorman and Hiltunen (2004) analysed its antioxidant activity by DPPH and ABTS assays, demonstrated the free radical-scavenging effect of *Satureja hortensis* L. extract. Moreover, besides antioxidant properties, antifungal, antibacterial and analgesic effects were discussed (Fathi *et al.*, 2013). While synthetic antioxidants, including butylated hydroxytoluene (BHT), or butylated hydroxyanisole (BHA) are known as causing serious health problems, the use of natural antioxidants ingredients from medicinal plants is of high interest.

Oil structuring is currently of high interest, due to the demonstrated negative health effects of *trans* fatty acids from artificial sources, mainly partially hydrogenated fats, as stated by recent regulations (European Commission, 2019; FDA, 2015), scientific reports and recommendations (EFSA, 2018; WHO, 2018). Structuring the liquid edible oil into a gelled system, with consistency similar of conventional *trans* or saturated fats, is extensively presented (Marangoni and Garti, 2018; Patel, 2018), several available techniques being available, including wax structuring. For current preliminary work, it is assumed that structuring oils rich in polyunsaturated fatty acids, will determine higher oil stability, as oxygen may diffuse more difficult into the gelled matrix.

Linolenic and linoleic acids are essential fatty acids, while human body cannot produce them; thus, the solely source is food. Main health benefits of flax seed oil are linked to its high α-linoleic acid content, known as one of the main polyunsaturated fatty acids. For example, Bozan and Temelli (2008) reported a linolenic acid content of 58.3%, while a similar value of 58.7% was measured by Teh and Birch (2013), proving that flax seed oil shows one of the highest levels of linoleic acid among food sources. As lipid oxidation involves polyunsaturated fatty acids (PUFAs) alteration, due to its PUFAs high content, flax seed oil is prone to oxidation. It is assumed that structuring the oil by an alternative method (wax crystallization) or the addition of a natural antioxidant (dried *Satureja hortensis* L.) will delay the oxidation of cold pressed flax seed oil.

Consequently, the aim of current preliminary study is to assess flax seed oil characteristics as affected by structuring or by addition of dried *Satureja hortensis* L.

Materials and methods

Plant material

Dried *Satureja hortensis* L. and cold pressed flax seed oil were purchased from producers located in Cluj County, Romania.

Sample preparation

The flax seed oil oleogel was prepared as follows: the cold pressed flax seed oil and 4% (w/w) beeswax were mixed and heated above the melting point of the used wax (65°C), on a magnetic stirrer hot plate. The melted wax and oil mixture was poured in 30 ml glass jars, and then cooled at room temperature, the flax seed oil oleogel being obtained (Fig.2.C). For the preparation of the cold pressed flax seed oil enriched with *Satureja hortensis* L., dried summer savory plants were weighted (0.25g) on 30 ml glass jars, the oil being then poured to fill the containers (Fig.2.B). The commercial breakfast spread, included in the texture analysis comparison, was purchased from a local supermarket.

Apparatus

Texture analysis was performed at 20±0.5°C, by using the Brookfield CT3 Texture analyser equipped with 10 kg load cell and the Spreadability Fixture (TA-SF, Brookfield Engineering; Fig.1.) was used in a simple compression analysis test (20 mm target value for deformation, 2 mm s^{-1} test and return speed). Texture Pro CT V1.6 software was used for computing the specific texture parameters.

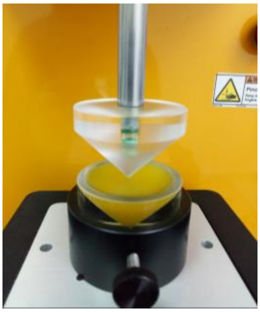


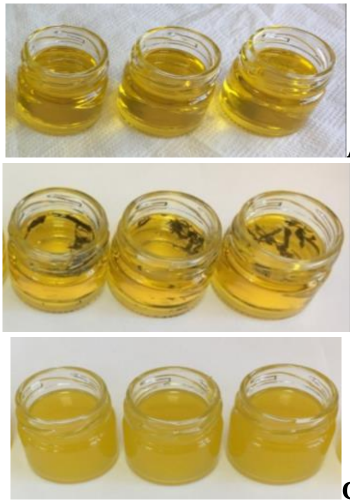
Fig.1. Spreadability Fixture (TA-SF, Brookfield Engineering) filled with flax seed oil oleogel

Results and discussions

Monitoring the peroxide value during storage for six weeks at room temperature

In order to follow the oxidative stability, a preliminary study included a short storage test at room temperature for the different control and treated cold pressed flax seed oil samples: flax seed oil (A), summer savory enriched flax seed oil (B), flax seed oil oleogel (c). The peroxide value (PV) measured initially was 1.2 meq O_2 /kg sample, irrespective of the sample, while after storing the samples at room temperature for six weeks, minor changes were noticed, a PV 1.6 meq O_2 /kg being measured for the flax seed oil control sample, 1.4 meq O_2 /kg for flax seed oil oleogel, and 1.2 meq O_2 /kg for the summer savory enriched flax seed oil. As expected, this preliminary study proved that both methods used, i.e., oil structuring and addition of dried *Satureja hortensis* L., proved an increased stability, further extensive studies being design in our lab for demonstrating their mechanisms of action.

The flax seed oil, summer savory enriched flax seed oil, as well as the obtained flax seed oil oleogel, prepared for the storage test, are presented on Figure 2.



A

B

C

Fig.2. Samples prepared for storage test: flax seed oil (A), summer savory enriched flax seed oil (B), flax seed oil oleogel (C)

Brief comparison between texture characteristics of structured flax seed oil and commercial breakfast spread

Spreadability is understood as a parameter which measures the ability of a sample to be spread in a thin and even layer, as performed by the spreadability fixture – an accessory that consists of a set of matched male and female cones (Fig.1). The spreadability of the flax seed oleogel as compared to a standard commercial available breakfast spread is presented in Fig.3. Higher hardness (max. positive load), adhesive force (max. negative load) and average peak load values were obtained for oleogel sample (3 times higher), as compared to standard breakfast spread; however, commercial breakfast spread sample showed a higher value for adhesiveness (area under the load vs. distance curve), as showed on Table 1.

Table 1

Overview of main texture characteristics

Samples	Hardness	Adhesive	Adhesiveness	Average Peak

	[g]	force [g]	[mJ]	Load [g]
Flax seed oil oleogel	3335±28	2523±127	17.3±1.3	3335±28
Commercial breakfast spread	1092±41	868±28	28.8±5.6	1092±41

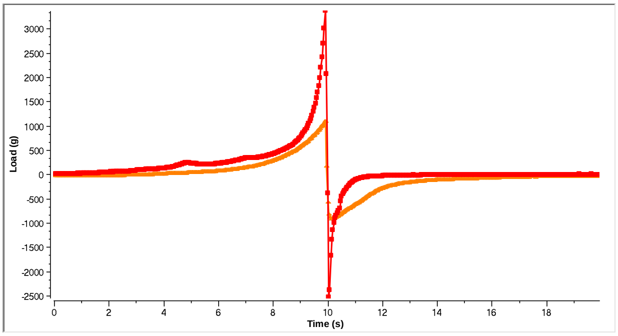


Fig.3. Spreadability of flax seed oil oleogel (■) as compared to commercial breakfast spread (●)

Conclusions

This preliminary storage test showed some trends of peroxide values during storage for six weeks, indicating that both methods might confer a higher oxidative stability for oil rich in polyunsaturated fatty acids. Comparing the textural parameters of the structured flax seed oil and the commercial breakfast spread analysed, encouraging results were obtained. However, it has to be pointed out that extensive studies are design and performed currently in our lab in order to optimize the lipid structurants (single compounds or mixtures) and techniques used for gelling the oil, as well as new structured oils behaviour during storage or incorporation in food.

Acknowledgement

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