**Technological, sensory, and nutritional assessment of eco-friendly food lipids**

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The first two activities of the PhD thesis project are described. Firstly, the characterization of different types of refined vegetable oils obtained from different matrices. Said oils were also stored and subsequently analysed following thermal and photooxidative stress. Secondly, the formulation and chemical analysis of different types of baked products, sweet and salty, that were stored for different periods of times, ranging from 0 to 75 days for “tarallini” and 0 to 355 days for “frollini” biscuits.

Valutazione tecnologica, sensoriale e nutrizionale di lipidi alimentari eco-sostenibili

Vengono di seguito descritte le prime due attività del progetto di tesi di dottorato. In primo luogo, la caratterizzazione di diversi tipi di oli vegetali raffinati ottenuti da diverse matrici, di seguito stoccati e successivamente analizzati a seguito di stress termico e foto ossidativo. In secondo luogo, la formulazione e l'analisi chimica di diverse tipologie di prodotti da forno, dolci e salati, che sono stati conservati per diversi periodi di tempo, che vanno da 0 a 75 giorni per i tarallini e da 0 a 355 giorni per i frollini.

**Key words**: Lipid oxidation, thermal stress, photooxidative stress, product formulation, chemical analysis

# **1. Introduction**

In accordance with the PhD thesis project previously described, this poster reports the main results of the first two activities concerning:

(A1) the characterization of different types of refined vegetable oils obtained from different matrices, highlighting also the behaviour following thermal and photooxidative stress.

 (A2) the formulation and chemical analysis of different types of baked products, sweet and salty, that were stored for different periods of times, ranging from 0 to 75 days for “tarallini” and 0 to 355 days for “frollini” biscuits.

**2. Materials and Methods**

# Preceding the methods described, extensive bibliographic research regarding the oil characteristics and production was made. The oil samples analysed in this research work have been acquired, partly through direct purchase in supermarkets premises (CONAD CITY Viale Gaspare Finali, 28, 47521 Cesena FC) and include: Extra Virgin Olive Oil Apruntino Pescarese DOP, Conad 0.75 liters (EVO), 1 liter "Olitalia" grape seed oil (V), 1 liter Conad sunflower oil (BO) and partly through direct supply from private individuals, specifically high oleic sunflower oil (AO). In particular, the analyses carried out on the oil samples were the following: the fatty acid composition b(FAME) by capillary gas chromatography, the peroxide value (PV), the volatile compounds by gas chromatographic analysis combined with mass spectrometry (SPME-GC-MS) (Purcaro et al., 2008), the *p*-anisidine value by spectrophotometric method (p-AV), and the oxidized fatty acids (OFA) by gas chromatographic analysis. The samples (about 10 g) were placed inside of 100 ml bottles with Sovirel caps and placed in an oven at 100°C for different times, as described in table 1. The same oil samples were treated with light (λ 150) for different periods of time, ranging from 0 to 480 minutes. For this experiment, a photooxidation chamber, made in laboratory, were used. The same analyses described for the thermally stressed samples, were conducted for this second test. After the characterization of said oils was conducted, a phase of product formulation came after, using samples normally buyable in convenience stores; said decision was made consequently the delays in the company experience. Five types of “tarallini” and six types of “frollini” biscuits were produced using the recipes highlighted in the tables.

# **3. Results and Discussion**

## **3.1 Vegetable oil characterization**

The oils were analysed and characterized and the results regarding the oxidative parameters are reported in Table 1. In summary both the high and low oleic sunflower oil showed the best attitudes for the baking products conditions, given the high content of relatively stable unsaturated fatty acids (both MUFA and PUFA) correlated to the high contents of α-tocopherol; rice oil showed a good aptitude to temperatures up to 180°C thanks also to the high concentration of γ-oryzanol; grapeseed oil was able to develop unique aromas (following thermal stress) and characteristics thanks to the high concentration of pigments and phenolic substances; finally, extra-virgin olive oil, as expected developed the oxidative parameters more than each other sample, but with values greatly under law limits .

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample | oil | Treatment time (min) | T° (°C) | Treatment time(min) | Wavelength(λ) |
| V0 | Grapeseed oil | 0 | 100 | 0 | 150 |
| V1 | 30 | 5 |
| V2 | 60 | 10 |
| V3 | 90 | 20 |
| V4 | 120 | 30 |
| V5 | 180 | 60 |
| V6 | 300 | 240 |
| V7 | / | / | 480 |
| BO0 | Low oleic sunflower oil | 0 | 100 | 0 | 150 |
| BO1 | 30 | 5 |
| BO2 | 60 | 10 |
| BO3 | 90 | 20 |
| BO4 | 120 | 30 |
| BO5 | 180 | 60 |
| BO6 | 300 | 240 |
| BO7 | / | / | 480 |
| AO0 | High oleic sunflower oil | 0 | 100 | 0 | 150 |
| AO1 | 30 | 5 |
| AO2 | 60 | 10 |
| AO3 | 90 | 20 |
| AO4 | 120 | 30 |
| AO5 | 180 | 60 |
| AO6 | 300 | 240 |
| AO7 | / | / | 480 |
| EVO0 | Extra virgin olive oil | 0 | 100 | 0 | 150 |
| EVO1 | 30 | 5 |
| EVO2 | 60 | 10 |
| EVO3 | 90 | 20 |
| EVO4 | 120 | 30 |
| EVO5 | 180 | 60 |
| EVO6 | 300 | 240 |
| EVO7 | / | / | 480 |

**Table 1**: *treatment sheet of the vegetable oil samples.*

**3.2 Product formulation**

Five different lipid formulations for “tarallini” and six different lipid formulations for “frollini” were taken into study. The fat blends used were compromised for each product with one standard formulation using “standard” industrial fats, indicated as 0 (palm oil for “frollini” and extra virgin olive oil for “tarallini”), and the remaining formulations being gradual increasing blends of alternative and industrial fats. All the fats used were not put through specific refining processes given the delays in the expected company period. The products obtained were then characterized, at different shelf-life periods (dark storage at 20°C) by: peroxide value analysis (Shantha N.C. E Decker E.A., 1994), volatile compounds composition by gas chromatography and mass spectrometry (SPME-GC-MS) and accelerated, general oxidation resistance, using an OXITEST® instrument (Riciputi and Caboni, 2017).

# **4. References**

Purcaro G, Moret S, Conte LS. Rapid SPE-HPLC determination of the 16 European priority polycyclic aromatic hydrocarbons in olive oils. J Sep Sci. 2008 Dec;31(22):3936-44. doi: 10.1002/jssc.200800392.

Shantha NC, Decker EA. Rapid, sensitive, iron-based spectrophotometric methods for determination of peroxide values of food lipids. J AOAC Int. 1994 Mar-Apr;77(2):421-4.

Riciputi Y, Caboni MF. Assessing oil oxidative stability in tarallini by OXITEST®. Ital J Food Sci [Internet]. 2017;29(1):63-73.