ISSN print: 1224-5984
ISSN online: 2248-3942

Rom Biotechnol Lett. 2023; 28(5): 4096–4100
doi: 10.25083/rbl/28.5/4096.4100

Received for publication, April, 08, 2024
Accepted, June, 06, 2024

Original article

Studies on the determination of the photo protective capacity of the mixture of camelina oil and grape seed oil

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Abstract

Camelina sativa is an annual plant, belonging to the family Brassicaceae, native to S-E Europe and South-West Asia, from whose seeds an oil of superior quality in composition is obtained. It has a saponifiable fraction represented by fatty acids, of which polyunsaturated ones are found in a proportion greater than 55%, and a non-saponifiable fraction represented by sterols and tocopherols. Camelina oil currently has multiple uses, from uses in the field of biofuels, it can be purified through specific technological processes and used to obtain products with different destinations: food supplements, ingredients for animal feed, cosmetics, and pharmaceuticals. Previous studies have shown that camelina oil also has an appreciable photoprotective capacity, which led to the desire to continue studies in this direction. This paper aims to analyze the photoprotective capacity of the mixture of camelina oil and grape seed oil, in different proportions, to obtain formulations of cosmetic products. Two samples were prepared – sample A (camelina oil 25g, grape oil 75g) and sample B (camelina oil 75g, grape oil 25g). Spectrophotometric analysis of 10 hexane solutions, with a concentration of 1%-10%, from each sample, at wavelengths between 290 and 320 nm. The sun protection factor determined by the equation Mansur et al (1986) has values between 3,097 and 21,156 for sample A, respectively between 3,153 and 24,089 for sample B, which indicates the possibility of using the mixture of camelina oil and grape oil in dermatologic formulations for solar protection.

Keywords

camelina oil, grape seed oil, photoprotective capacity.

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Introduction

Camelina [*Camelina sativa* L. Crantz] is a dicotyledonous plant of the Brassicaceae family, popularly known as "false flax", flax egg [1] or heartworm [2].

In the composition of camelina oil, two fractions can be distinguished: one unsaponifiable (tocopherols, sterols) and another saponifiable (fatty acids).

The fatty acid profile is mainly represented by unsaturated fatty acids – mono and mainly polyunsaturated (>55%) and saturated fatty acids (9.1-10.8%) [3].

Previous studies [4] have shown that camelina oil also has an appreciable photoprotective capacity, which led to the desire to continue studies in this direction. This paper aims to analyze the photoprotective capacity of the mixture of camelina oil and grape seed oil, in different proportions, to obtain formulations of dermato-cosmetic products. The Austrian scientist, Franz Greiter, first proposed the concept of sun protection factor, and then sequentially adopted by many authorities in the pharmaceutical and cosmetics industry. He was talking about how long the skin covered with photoprotective agents can stay in the sun until sunburn occurs compared to the time it takes for unprotected skin. SPF is a numerical evaluation system that indicates the degree of protection of the cosmetic product. It is defined as the ratio between the value of UV energy required to produce erythema on protected skin and the value of UV energy required to produce the same erythema on unprotected skin.

Materials and methods

Materials

The biological material used was camelina oil and grape seed oil.

The camelina oil was obtained from seeds of the Madalina variety, coming from a crop established at the Moara Domneasca Didactic Farm, by the cold pressing method, followed by decantation and separation [5].

The grape seed oil was purchased from an authorized distributor of cosmetic ingredients.

Preparation of the oil mixture

I prepared two samples, mixtures of camelina oil with grape oil, respectively sample A (mixture of camelina oil and grape oil obtained by mixing, at room temperature, 25 grams of camelina oil with 75 grams of grape oil), respectively sample B (mixture of camelina oil and grape oil obtained by mixing, at room temperature, 75 grams of camelina oil with 25 grams of grape oil).

From the mixture of oils thus obtained, 10 samples were prepared, hexane oil solutions with concentrations between 1 and 10%.

For each sample, the absorption spectra were recorded in the wavelength range 290-320 nm with the 0.5 nm step, using the RayLeigh-UV-2601 spectrophotometer, using 1 cm cuvettes.

Processing of the data obtained

For the calculation of the protection factor, the equation Mansur et al (1986) was used:

$$SPF = 10 \sum_{290}^{320} F(\lambda) * Abs(\lambda)$$

where:

SPF – sun protection factor determined by spectrophotometry

F – correction factor whose values depend on the wavelength

Abs – absorbance of the solution recorded at a certain wavelength (λ).

The recorded data were statistically processed [6].

Results and discussions

From the analysis of the absorbance values for the analyzed samples, we notice that at the same wavelength, the absorbance increases with the increase of the concentration of the analyzed sample, except for the 2% concentration sample, at which we observe a decrease in absorbance for all 10 samples, as well as for the 9% concentration solution, for which the absorbance decreases for λ=290nm, and for the other wavelengths the absorbance value increases.

We also notice that, for the same concentration of the sample, the absorbance value decreases with the increase of the wavelength (from 0.606 to 0.193 in the case of the 1% concentration sample). From the analysis of the absorbance values for the analyzed samples, we notice that at the same wavelength the absorbance increases with the increase of the concentration of the analyzed sample (for example, at λ=290 nm, the absorbance increases from 0.479 for the 1% concentration sample to 3.093 for the 10% concentration sample).

We also note that for the same sample concentration, the absorbance value decreases with increasing wavelength (from 0.479 to 0.216 in the case of the 1% concentration sample), except λ = 315nm, the absorbance wavelength increases for most samples.

The absorption spectra for the analyzed samples are shown in Figure 1.A. and 1.B, respectively.

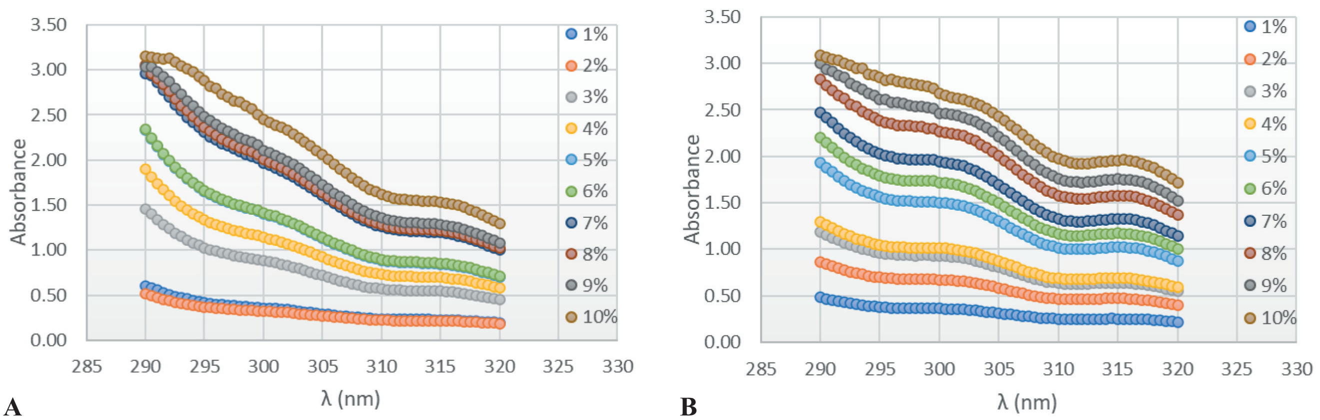
In Table 2. the values of SPF determined experimentally, obtained with the help of the equation Mansur et al. (1986), together with the values predicted by the SPF based on the regression line, depending on the concentration for samples A-B, oil obtained by mixture of camelina oil and grape oil.

Table 1.A. Absorbance values in the range λ = 290-320nm for the analyzed samples, solutions camelina oil 25% + grape oil 75%, in hexane, in concentration from 1% to 10% together with the corresponding correction factor for calculating the SPF value

λ(nm)	Corectie	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
290	0.015	0.606	0.513	1.461	1.897	2.330	2.345	2.964	3.059	3.037	3.155
295	0.0817	0.420	0.370	1.028	1.338	1.654	1.665	2.308	2.368	2.489	2.884
300	0.2874	0.359	0.323	0.884	1.143	1.406	1.416	1.966	2.005	2.108	2.452
305	0.3278	0.294	0.270	0.717	0.926	1.137	1.146	1.605	1.640	1.729	2.057
310	0.1864	0.237	0.223	0.568	0.729	0.889	0.900	1.257	1.283	1.356	1.620
315	0.0837	0.228	0.215	0.544	0.696	0.846	0.856	1.192	1.217	1.286	1.534
320	0.018	0.193	0.186	0.454	0.580	0.704	0.715	0.999	1.023	1.081	1.295

Table 1.B. Absorbent values in the range λ = 290-320nm for the analyzed samples, hexane solutions of the oil obtained as a mixture of camelina oil and grape seed oil in a 75:25 ratio (sample B), in concentration from 1% to 10% together with the corresponding correction factor for calculating the SPF value

λ(nm)	Corectie	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
290	0.015	0.479	0.859	1.189	1.298	1.930	2.198	2.473	2.835	2.998	3.093
295	0.0817	0.379	0.696	0.960	1.047	1.563	1.791	2.030	2.388	2.617	2.854
300	0.2874	0.361	0.673	0.929	1.013	1.504	1.718	1.938	2.266	2.465	2.677
305	0.3278	0.311	0.583	0.804	0.875	1.303	1.495	1.697	2.006	2.216	2.433
310	0.1864	0.250	0.464	0.633	0.684	1.017	1.169	1.326	1.581	1.763	1.972
315	0.0837	0.251	0.469	0.639	0.691	1.022	1.171	1.328	1.577	1.755	1.958
320	0.018	0.216	0.401	0.545	0.587	0.874	1.005	1.141	1.365	1.527	1.718



A B

Fig. 1.A. Absorption spectra for sample A, (hexane solutions of oil obtained as a mixture of camelina oil and grape seed oil in a 25:75 ratio), in concentration from 1% to 10% in the range λ = 290-320nm; B. Absorption spectra for B samples, (hexane solutions of the oil obtained as a mixture of camelina oil and grape seed oil in a 75:25 ratio), in concentration from 1% to 10% on the range λ = 290-320nm

Table 2. The experimentally determined SPF values together with the predicted SPF values based on the regression lines, depending on the concentration for samples A and B respectively of camelina oil and grape oil mixture (hexane solvent)

Conc (%)	SPF A	SPF B
1%	3.097	3.153
2%	2.822	5.872
3%	7.546	8.081
4%	9.744	8.789
5%	11.961	13.069
6%	12.061	14.971
7%	16.762	16.951
8%	17.126	19.977
9%	18.014	21.966
10%	21.156	24.089

Conc (%)	SPF A	SPF B
11%	23.293	26.590
12%	25.341	28.935
13%	27.389	31.280
14%	29.438	33.625
15%	31.486	35.970
16%	33.534	38.315
17%	35.582	40.661
18%	37.630	43.006
19%	39.678	45.351
20%	41.726	47.696

Data analysis reveals higher values of sunscreen factor for sample B compared to sample A, for each concentration taken in the study.

Higher values of the sun protection factor for sample B compared to sample A also show the graphic representation in Figure 2.

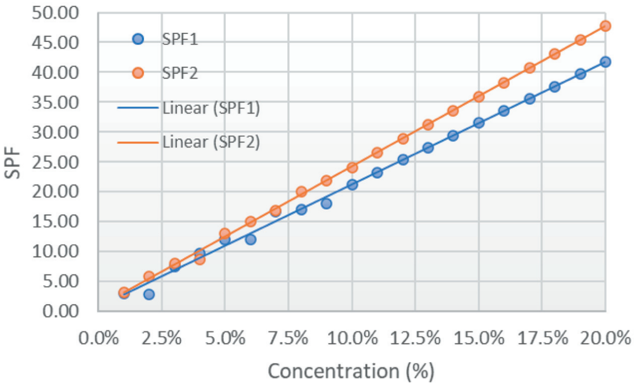


Fig. 2.. Scatter Plot representation of the experimental SPF values, the predicted SPF values based on the model validated by the linear regression analysis according to concentration for samples A, respectively prone B of camelina oil and grape oil mixture (hexane solvent)

Analysis of the influence of the concentration factor 1%-20% on SPF values:

There are significant differences between the average SPF values corresponding to each concentration 1%-20% (Table 3., Figure 3.) in the sense that, as the concentration increases, the SPF increases (F = 168.291 > F-crit = 2.168, p < 0.001).

Analysis of the influence of sample factor 1-2 on SPF values: There are significant differences between the mean SPF values corresponding to each sample A-B (Table 3., Figure 4.) in the sense that, as the camelina concentration increases from 25% to 75%, the SPF increases (F = 49.341 > F-crit = 4.381, p < 0.001).

Table 3. Anova Test Analysis Result: Two-Factor Without Replication.

SUMMARY	Count	Sum	Average	Variance	SD
1%	2	6.250	3.125	0.002	0.040
2%	2	8.694	4.347	4.653	2.157
3%	2	15.627	7.813	0.143	0.378
4%	2	18.533	9.266	0.456	0.675
5%	2	25.029	12.515	0.614	0.783
6%	2	27.032	13.516	4.234	2.058
7%	2	33.713	16.856	0.018	0.133
8%	2	37.103	18.552	4.064	2.016
9%	2	39.980	19.990	7.812	2.795
10%	2	45.245	22.622	4.300	2.074
11%	2	49.883	24.942	5.434	2.331
12%	2	54.276	27.138	6.457	2.541
13%	2	58.670	29.335	7.569	2.751
14%	2	63.063	31.531	8.768	2.961
15%	2	67.456	33.728	10.056	3.171
16%	2	71.849	35.925	11.432	3.381
17%	2	76.242	38.121	12.897	3.591
18%	2	80.635	40.318	14.449	3.801
19%	2	85.029	42.514	16.090	4.011
20%	2	89.422	44.711	17.819	4.221
SPF1	20	445.384	22.269	147.409	12.141
SPF2	20	508.346	25.417	192.627	13.879

ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Rows	6422.509	19	338.027	168.291	0.000	2.168
Columns	99.10472	1	99.105	49.341	0.000	4.381
Error	38.16308	19	2.009			
Total	6559.777	39				

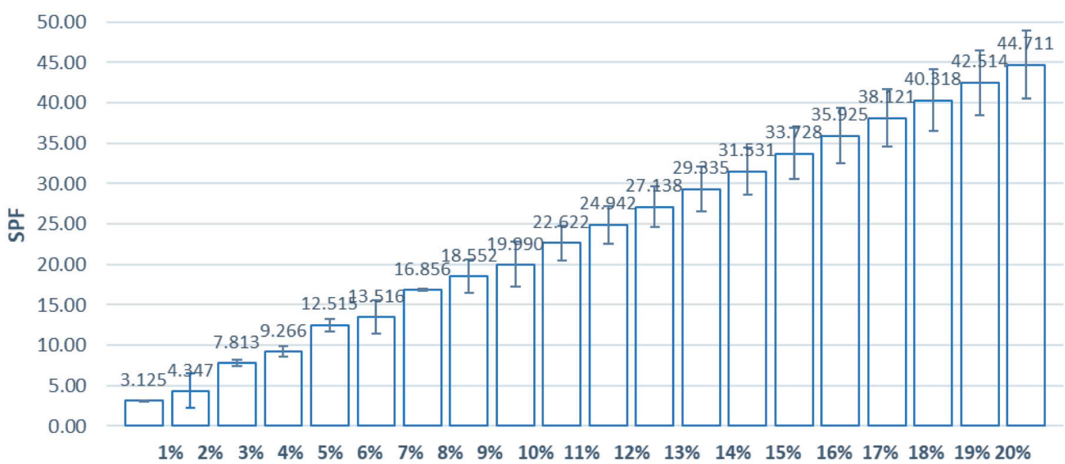


Fig. 3. Bar-Error Bar representation of the average SPF values corresponding to the concentration factor 1%-20%.

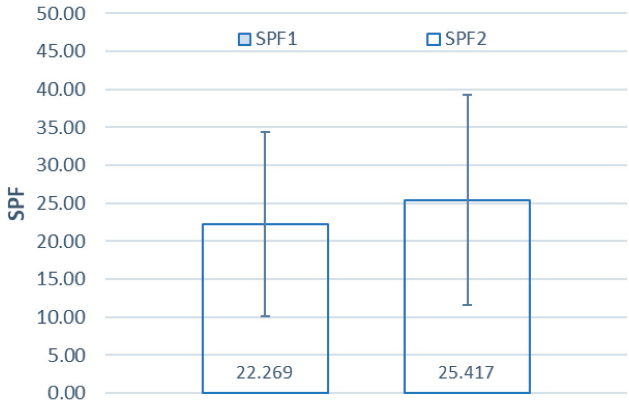


Fig. 4. Bar-Error Bar representation of the average SPF values corresponding to the sample factor A-B.

Conclusions

The oil obtained as a mixture of camelina oil and grape seed oil in a 25:75 ratio analyzed has a satisfactory photoprotective capacity for a dermocosmetic product, the SPF being between 3,097 for the 1% concentration solution and 41,726 for the 20% concentration solution.

The oil obtained as a mixture of camelina oil and grape seed oil in a 75:25 ratio analyzed has a satisfactory photoprotective capacity for a dermatocosmetic product, the SPF being between 3,153 for the 1% concentration solution and 47,696 for the 20% concentration solution.

The oil obtained as a mixture of camelina oil and grape seed oil in a 75:25 ratio analyzed has a higher photoprotective capacity than the oil obtained as a mixture of camelina oil and grape seed oil in a 25:75 ratio, at 1% concentration having SPF 3,153 compared to 3,097, respectively at 20% concentration it has SPF 47,696 compared to 41,726.

There are significant differences between the mean SPF values corresponding to each concentration of 1%-20% in the sense that, as the concentration increases, the SPF increases ($F = 168.291 > F\text{-crit} = 2.168$, $p < 0.001$).

There are significant differences between the average SPF values corresponding to each A-B sample in the sense that, as the camelina concentration increases from 25% to 75%, the SPF increases ($F = 49.341 > F\text{-crit} = 4.381$, $p < 0.001$).

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