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DISCUSSION PAPER ON A PROPOSAL TO AMEND THE CODEX STANDARD FOR NAMED VEGETABLE OILS: SUNFLOWER SEED OILS (CODEX STAN 210-1999)

Prepared by Argentina

Fatty acid composition of the oil from traditional sunflower hybrids

1. Introduction

The fatty acid composition of sunflower oil is strongly determined by the hybrid and by the weather conditions during the grain filling stage. That is why the oil from different hybrids sown at the same time may present variable fatty acid composition, while the fatty acid composition of one hybrid may vary depending on the sowing date. In this sense, both minimum night temperature and the amount of light the plant leaves absorb throughout the grain filling (Izquierdo & Aguirrezábal, 2008; Izquierdo et al, 2009) increase the oleic acid percentage and decrease that of linoleic acid. Consequently, the difference in the oleic acid percentage may be, for instance, of up to 40 percentage points due to temperature variations, and of up to 10 points due to variations in the amount of light absorbed. The appearance of new sunflower hybrids on the market, along with the fact that the Argentine sunflower region -presently covering latitudes from 25 to 36°S approximately- has extended to warmer areas has resulted in the appearance of sunflower seed oils of authentic samples with a fatty acid composition beyond the ranges set up to the moment.

Consequently, it becomes necessary to explore the fatty acid composition of the oil from different sunflower hybrids presently available on the market, grown in different areas of the country.

The objective of this work was to perform a preliminary determination of the fatty acid composition of traditional sunflower hybrids grown in the northern area (latitude < 30°S) of the Argentine Republic with the aim of setting the abundance range of different fatty acids in the warmer areas of sunflower production. This characterization is the first progress in a two-stage study which is being carried out at present. For the 2012/2013 season, the goal is to complete this study with a larger number of samples (105) which will be obtained from five hybrids sown in seven towns (Las Breñas, Presidencia Roque Sáenz Peña, Villa Ocampo, Tostado, Reconquista, Bandera and Logroño) located in the provinces of Chaco, Santa Fé and Santiago del Estero, all of them in the northern part of the region where sunflower is grown in the Argentine Republic.

2. Sampling

Samples of traditional sunflower hybrids of the National Network of multienvironment **trials** of INTA from the 2011-2012 season were analyzed. This Network is composed of a set of about thirty-five commercial hybrids and sixty experiments, spread all over the region where sunflower is grown in Argentina. The INTA's professional staff and collaborators are responsible for the choice of the experimental area to implant the trials, weed and plague control, follow-up, assessment and note-taking, collection of the material and data processing.

The trials comply in methodology with protocols which assure the reliability of the results. The hybrids included in each trial are chosen by seed supplier companies, who select for those they consider suitable for that environment. In addition to the competence of those responsible for conducting the trials, the Network includes an External Technical Auditing performed by independent professionals selected with the

agreement of the involved parties. The results that are published are only those related to the trials which comply with the standard quality criteria. The samples analyzed in this report come from trials complying with such criteria.

The samples of the present report are originally from two towns: Reconquista (Province of Santa Fé, 29°S) and Presidencia Roque Sáenz Peña (Province of Chaco, 26°S). The experimental design was in randomized complete blocks with three replications. Each plot was composed of four rows and the experimental unit (EU) was constituted by the two central rows. At stage R9 (Schneiter & Miller, 1981), the whole lot of flowers of each EU was harvested and threshed. From each EU, a 30-gram subsample was taken for quality estimation (oil and fatty acid content). In the case of the town of P. R. S. Peña, the material analyzed was a 90-gram sample formed by the mix, in equal parts, of achenes coming from the three replications of each hybrid. The samples represent the combination of hybrids, towns and replications detailed in Table 1.

Table 1- Town, hybrid and replication of each sample. M= mix composed of achenes from the three trial replications.

Sample	Town	Hybrids	Replication
1	Reconquista	PAN 7076	I
2	Reconquista	PAN 7076	II
3	Reconquista	ACA 887	I
4	Reconquista	ACA 887	II
5	Reconquista	DK 4045	I
6	Reconquista	DK 4045	II
7	Reconquista	DK 4065	I
8	Reconquista	DK 4065	II
9	Reconquista	HUARPE	I
10	Reconquista	HUARPE	II
11	P.R.S. Peña	ACA 887	M
12	P.R.S. Peña	PAN 7076	M
13	P.R.S. Peña	DK 4065	M
14	P.R.S. Peña	DK 4045	M
15	Reconquista	ARGENSOL 40	I
16	Reconquista	ARGENSOL 40	II
17	Reconquista	CACIQUE 308 CL	I
18	Reconquista	CACIQUE 308 CL	II
19	Reconquista	SPS 3120	I
20	Reconquista	SPS 3120	II
21	Reconquista	TOBSOL 261	I
22	Reconquista	TOBSOL 261	II
23	Reconquista	SY3930 CL	I
24	Reconquista	SY3930 CL	II
25	P.R.S. Peña	ARGENSOL 40	M
26	P.R.S. Peña	CACIQUE 308 CL	M
27	P.R.S. Peña	SPS 3120	M
28	P.R.S. Peña	TOBSOL 261	M
29	P.R.S. Peña	SY3930 CL	M

3. Analytical Methodology

Oil was extracted from 10-15 grams of grains ground using n-hexane as solvent. The sample was placed in filter paper cartridges inside soxhlet bodies in order to extract it. Extraction was done through percolation-immersion for three hours at 80ºC. After extraction, the solvent was recovered with a rotavapor with vacuum at 45ºC. The remains of the oil solvent were eliminated with a flow of N_2. The oils were kept in caramel-colored jars in an atmosphere of N_2 at 5ºC.

The fatty acids present in the oil were methylated following the technique proposed by Sukhija & Palmquist (1988). For this purpose, the oil samples dissolved in chloroform were incubated with 1 volume of methanolic acid 5% (acetyl chloride: methanol; 1:10, v/v) at 70ºC for an hour. After the addition of 4 volumes of potassium carbonate 6% (w/v), the preparations were incubated until phase separation, and the organic phase was supplemented with 2 volumes of chloroform. The fatty acid composition was determined by gas chromatography (GLC) with a Shimadzu GH-2014 (Kyoto, Japan) equipment. The injector and detector (FID) temperatures were of 250 and 275ºC respectively, whereas the temperature of the column was of 210ºC. 1 □L of sample was injected in the column (Omega wax 250, Supelco). The N_2 carrier gas was kept at a constant pressure of 100 kPa. The chromatograms obtained were acquired and processed using Shimadzu GC-solution software.

4. Results and conclusions

The percentage ranges of the fatty acids of the oil from sunflower grown in the mentioned towns are detailed on Table 2.

Table 2- Abundance range (percentage) of each fatty acid in the sunflower seed oil.

Fatty Acid	Abundance (%)
C 16:0	4.3-6.0
C 18:0	2.0-6.2
C 18:1	28.2-61.1
C 18:2	29.5-62.7
C 18:3	0.0-0.1
C 20:0	0.1-0.4
C 22:0	0.5-0.9
C 22:1	0.0-0.1
C 24:0	0.2

According to the results obtained in this first report, the ranges expressed in the table proposed by CODEX STAN 210-1999 are not valid for all the traditional hybrids grown in all the towns of the Argentine sunflower region. In the north of Argentina, the oleic acid values would be higher and the linoleic acid values lower, mainly due to the warm temperatures usually present at the grain filling stage.

The fatty acid composition of all the samples is laid out in detail in the Appendix accompanying the present report (Table 3)

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5. Appendix - Table 3 shows the fatty acid composition (percentages) of the analyzed samples.

Sample	C 16:0	C 18:0	C 18:1	C 18:2	C 18:3	C 20:0	C 22:0	C 22:1	C 24:0
1	5.7	3.9	33.8	55.4	0.0	0.2	0.6	0.1	0.2
2	5.7	4.1	33.8	55.2	0.0	0.3	0.7	0.0	0.2
3	5.8	2.2	32.2	58.8	0.1	0.2	0.5	0.1	0.2
4	6.0	2.0	28.5	62.5	0.0	0.1	0.5	0.1	0.2
5	5.5	2.7	40.2	50.6	0.0	0.2	0.6	0.1	0.2
6	5.7	2.8	36.6	53.8	0.0	0.2	0.6	0.1	0.2
7	5.2	4.3	37.0	52.2	0.0	0.3	0.7	0.1	0.2
8	5.1	4.6	37.5	51.5	0.0	0.3	0.7	0.1	0.2
9	5.4	3.0	56.2	34.3	0.1	0.2	0.6	0.0	0.2
10	5.2	3.1	61.1	29.5	0.0	0.2	0.6	0.1	0.2
11	5.9	2.8	38.3	52.0	0.0	0.2	0.5	0.1	0.2
12	4.7	4.6	44.2	45.0	0.0	0.3	0.7	0.1	0.2
13	4.8	6.2	44.1	43.3	0.0	0.4	0.9	0.1	0.2
14	5.1	4.0	48.4	41.1	0.0	0.3	0.8	0.1	0.2
15	4.8	3.0	29.2	61.9	0.0	0.2	0.5	0.1	0.2
16	4.8	2.9	28.5	62.7	0.1	0.2	0.5	0.1	0.2
17	5.7	2.0	40.4	50.6	0.0	0.2	0.6	0.1	0.2
18	4.9	2.3	53.4	38.2	0.0	0.2	0.7	0.1	0.2
19	5.6	3.1	33.3	56.9	0.0	0.2	0.6	0.1	0.2
20	5.3	2.9	32.8	58.0	0.1	0.2	0.6	0.1	0.2
21	6.0	2.2	28.2	62.5	0.0	0.2	0.5	0.1	0.2
22	5.4	2.4	32.2	58.9	0.0	0.2	0.5	0.1	0.2
23	5.9	3.3	37.1	52.4	0.0	0.3	0.7	0.0	0.2
24	5.7	3.1	35.0	54.9	0.0	0.3	0.7	0.1	0.2
25	4.3	4.2	37.4	52.9	0.1	0.3	0.6	0.1	0.2
26	5.0	2.7	47.2	43.7	0.0	0.2	0.7	0.1	0.2
27	4.9	4.8	41.2	47.5	0.1	0.3	0.8	0.1	0.2
28	5.0	3.2	38.3	52.2	0.0	0.2	0.7	0.1	0.2
29	4.9	4.6	42.0	46.9	0.0	0.3	0.8	0.1	0.2