STABILITY OF RAPESEED OIL

L.Masson; D.Moreno; H.Oliver; E.Wittig. Lab.Food Chem. University of Chile.Vicuña Mackenna 20.Santiago.Chile.

INTRODUCTION

It is known that light is one of the most important factors in developing oxidative deterioration in fats and oils during storage, which affects their flavor characteristics.(1,2,3). Fioriti and coworkers (4) oxidized various commercial fats at elevated temperatures and they informed good correlation between the data obtained with pentane values, oxigen absortion,peroxide value and the average flavor scores. Recently,Huang (5) compared the stability of sunflower and corn oil stored at different conditions for various periods of time. Sunflower oil developed peroxides more rapidly than corn oil, but their organoleptic scores were not affected.

The present work was oriented to study the stability of refined rapeseed oil at different storage conditions in order to predict its durability through chemical and organoleptic tests.

EXPERIMENTAL PROCEDURE

Meterials and Methods

Refined rapeseed oil just before to get the market, was provided for a national factory. It contained 0.02% Tenox 20 (20 % TBHQ, 10 % citric acid and 70 % propilenglicol). To simulate market conditions, individuals bottles of polyethylene (PET) and polyvinyl chloride (PVC) with the rapeseed oil were stored at 15°C and 25°C in the dark, and at 25°C under diffuse daylight for 24 weeks. In parallel, the rapeseed oil was submitted to acelerated stability test such as AOM (6) and Schaal (7) methods.

Linoleic and linolenic acid content determined by GLC was 12,6 and 8,2 % respectively.

To follow the oxidation rate, peroxide value (PV) (8), p-anisidine value (p-AV) (9,10), free fatty acids (11) and sensory evaluation through triangular test (12) were done.

RESULTS AND DISCUSSION

Chemical assays

Controls were done once a week, but in Table 1 and 2 will be shown only the data obtained each four weeks for PET and PVC package respectively.

From the results it is clear that daylight was the main agent to promote oxidation in both packages, because at the end of the experimental period (24 weeks) rapeseed oil shown a PV of 21.2 and a p-AV of 30.3 in PET and a PV of 19.2 and a p-AV of 30.4 in PVC. The values obtained for the same period at the same temperature in dark, were close to those got at 15°C in dark. These results agree with the literature data (1,2,3). The type of the package didn't show practically any influence. The regression equations obtained for PV and p-AV at the different conditions studied in both packages are the following:

PET 15° dark:	$y = 0.699\ x - 1.196$	$r = 0.998$
PET 25° dark:	$y = 0.607\ x - 0.794$	$r = 0.997$
PET 25° daylight:	$y = 0.695\ x - 1.042$	$r = 0.998$
PVC 15° dark:	$y = 0.702\ x - 1.316$	$r = 0.994$
PVC 25° dark:	$y = 0.639\ x - 1.053$	$r = 0.994$
PVC 25° daylight:	$y = 0.655\ x - 0.655$	$r = 0.999$

Where: y = Peroxide value (PV) meq/kg of fat
x = p-Anisidine value (p-AV)

Free fatty acids content, as was expected, didn't show a great change, at point zero it was 0.04 % expressed in oleic acid, and at the end of the experimental period reached an average value of 0.07 % for all the conditions tested.

AOM and Schaal tests were conducted until to get aproximately a Peroxide value (PV) of 100 meq/kg of fat. Samples for AOM were taken each two hours, and each two or three days for Schaal method. The results are summarized in Table 3. Rapeseed oil reached a PV of 100 meq/kg of fat at practically 26 hours of heating in AOM, and between 35 and 40 days for Schaal test. The p-AV was 177,8 and between 132,0 and 175,0 for both methods

respectively. The regression equations obtained for PV and p-AV in both assays are the following:

AOM	$y = 0.613\ x + 0.06$	$r = 0.998$
Schaal	$y = 0.658\ x + 0.134$	$r = 0.997$

Where: y = Peroxide value (PV)
x = p-Anisidine value (p-AV)

In order to know if there was any relationship for an equal Peroxide value (PV) between the time in hours through AOM, the time in days for Schaal test and the time in weeks for rapeseed oil stored at different conditions, regression equations were calculated for this edible oil bottled in PET, because results in PVC were similar. The obtained data are:

For AOM:

PET 25°C daylight	$y = 0.492\ x - 0.449$	$r = 0.996$
PET 25°C dark	$y = 0.253\ x - 0.952$	$r = 0.996$
PET 15°C dark	$y = 0.211\ x - 0.563$	$r = 0.999$

Where: y = time in hours AOM to get a definite PV.
x = time in weeks to get the same PV in the established storage conditions.

For Schaal test:

PET 25°C daylight	$y = 0.800\ x + 1.735$	$r = 0.978$
PET 25°C dark	$y = 0.665\ x - 2.917$	$r = 0.989$
PET 15°C dark	$y = 0.654\ x - 3.273$	$r = 0.985$

Where: y = time in days to get a definite PV.
x = time in weeks to get the same PV in the established storage condition.

These results shown a better correlation between AOM than Schaal test with the 24 weeks storage test at different conditions. The purpose of this part of the study was to find a rapid way, such as AOM, to predict the behaviour of refined rapeseed oil bottled in PET or PVC in storage conditions close to habitual marketing.

Sensory evaluation

Part of the samples taken for the chemical analysis were submitted to organoleptic evaluation, in order to determine at what level of PV and p-AV the panel of six trained judges could detect the initial point of the oxidative deterioration. During these assays, the panel didn't find significative differences between the rapeseed oil bottled in PET or PVC at the different esta-

blished storage conditions. For this reason, only the results got for PET package corresponding to the assay of storage during 24 weeks at 25°C daylight, will be shown in Table 4, together with the results got for AOM and Schaal test. From these results it is possible to say that in the acelerated tests, the level of PV indicating oxidative deterioration was between 20 and 23 meq/kg of fat, corresponding to 12 hours or 21 days of heating according to AOM and Schaal test respectively. Because in these tests the rate of oxidation was higher than in storage test, due to the more drastic conditions imposed by high temperature, it was considered necessary to adjust more closely, through sensory evaluation, the point where oxidative off-flavor was detected. As it is shown in Table 4, this level was at a PV of 16.3 in PET at 25°C daylight, which was obtained at 21 weeks of storage.

For this reason a peroxide value of 15 meq/kg of fat, which corresponds to a p-anisidine value of about 25, was considered the level where a trained panel can detect oxidative deterioration in this rapeseed oil.

As a security limit, a maximun of peroxide value of 12 meq/kg of fat is proposed.

According to the regression equations calculated between AOM and stability storage experiments, and considering a peroxide value of 12 as the maximun limit for this edible oil, it is possible to predict a period of durability of about 42 weeks for this rapeseed oil stored at 15°C dark, 36 weeks stored at 25°C dark and 18 weeks stored at 25°C daylight for PET or PVC packages.

TABLE 1: Peroxide value (PV) and p-Anisidine value (p-AV) obtained for Rapeseed oil in polyethylene bottles (PET).

Time	15°C dark		25°C dark		25°C daylight	
weeks	P.V.	p-A.V.	P.V.	p-A.V.	P.V.	p-A.V.
0	0.3	1.9	0.3	1.9	0.3	1.9
4	0.6	2.5	0.6	2.5	2.4	4.5
8	1.0	3.3	1.2	3.4	4.7	8.3
12	1.8	4.5	2.0	4.9	7.5	12.2
16	2.7	5.6	3.0	6.3	10.6	17.4
20	3.6	7.0	4.4	9.3	14.7	22.8
24	5.1	8.9	6.5	12.1	21.2	30.3

TABLE 2: Peroxide value (PV) and p-Anisidine value (p-AV) obtained for Rapeseed oil in polyvinyl chloride bottles (PVC).

Time	15°C dark		25°C dark		25°C daylight	
weeks	P.V.	p-A.V.	P.V.	p-A.V.	P.V.	p-A.V.
0	0.3	1.9	0.3	1.9	0.3	1.9
4	0.5	2.4	0.6	2.4	2.0	3.8
8	0.8	3.3	1.1	3.3	4.5	7.8
12	1.4	4.3	1.8	4.4	7.4	12.2
16	2.4	5.5	2.7	6.3	10.0	16.5
20	3.6	6.8	4.2	8.0	14.4	22.8
24	4.8	8.5	5.6	10.1	19.2	30.4

TABLE 3: Peroxide value (PV) and p-Anisidine value (p-AV) obtained for Rapeseed oil through AOM (hours) and Schaal test (days).

A.O.M.			Schaal test		
Time hours	P.V.	p-A.V.	Time days	P.V.	p-A.V.
0	0.3	1.9	0	0.3	1.9
4	6.9	11.3	9	3.6	7.2
8	11.8	19.1	18	16.8	25.3
12	20.3	36.1	21	23.4	36.9
18	46.6	74.4	25	39.0	58.6
24	89.5	144.8	35	94.2	132.0
25	97.0	162.5	40	117.6	175.0
26	106.2	177.8	43	126.1	205.2

TABLE 4: Sensory evaluation to detect the level of PV and p-AV where oxidative deterioration starts.

Test	PV	p-AV	Total correct judgments	x^2= chi square	Time
AOM	20.3	36.1	15	54.19	12 hours
Schaal	23.4	36.9	16	67.69	21 days
PET 25°C light	14.7	22.8	5	0.19	20 weeks
PET 25°C light	16.3	25.4	14	42.19	21 weeks
PET 25°C light	17.6	26.4	16	67.69	22 weeks

Nº judges = 6; Nº repetitions = 3; total judgments=18 minimum of judgments to establish significative diferentiation (p= 0.05) between sample and control= 10.
$x^2_{(p=0.05)} = 2.71$

REFERENCES

1.- Moser H.A., Evans C.D., Cowan J.C. and Kwolek W. F. JAOCS 42:30 (1965).
2.- Moser H.A., Evans C.D., Mustakas G., and Cowan J. C. Ibid. 42:811 (1965).
3.- Sattar A., Deman J.M., Ibid. 53:473 (1976).
4.- Fioriti J.A., Kanuk M.J., and Sims R.J. Ibid. 51: 219 (1974).
5.- Huang A.S., Hsieh O.A.L., Huang C.L., and Chang S.S. Ibid. 58:997 (1981).
6.- Official and Tentative Methods of The A.O.C.S. Active Oxigen Method Cd 12-57. Edition 1973.
7.- Joymer N.T., and Mc Intyre J.E. Oil and Soap 15: 184 (1946).
8.- Official and Tentative Methods of The A.O.C.S. Peroxide Value Cd 8-53. Edition 1973.
9.- List G.R., Evans C.D., Kwolek W.F., Warner K., Boundy B.K. and Cowan J.C.; J.A.O.C.S. 51:17 (1974).
10.- Fats and Oils, p-Anisidine number. Proyecto UNE 55-127. Grasas y Aceites 31:32 A (1980).
11.- Official and Tentative Methods of The A.O.C.S. Free Fatty Acids Ca 5a-40. Edition 1973.
12.- Bengtsson K.Svenska Bryggareforen Manadsblad 58: 59, 102, 149 (1943).