EXAMINATION OF SAFFLOWER OIL FROM INDIGENOUS SOURCES WITH REFERENCE TO ITS USE IN THE MANUFACTURE OF PAINTS AND VARNISHES

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Introduction

Safflower has become increasingly important in recent times because it is exceptionally rich in linoleic acid. The safflower oil contains 75-78% linoleic glyceride with little or none of the linolenic glyceride, which gives it excellent non-yellowing and colour retention properties, and makes the oil very suitable for the manufacture of oil-modified alkyd resins and similar products. The oil itself is reported[1] to dry to a hard film within eight hours in the presence of 0.03% Co and 0.3% Pb, and can therefore be used to advantage in place of linseed oil in the manufacture of oil paints.

Safflower oil is obtained from the seeds of "*carthamus Tinctorius*," a thistle-like plant which has been cultivated in India, China and Egypt, since ancient times for the production of a red-dyestuff (carthamin) obtained from the florets, and also for the extraction of edible oil from the seeds. As carthamin has now been compeltely replaced by aniline colours in the textile field and finds only a limited use in cosmetics, the oil-bearing varieties of this plant are now being especially cultivated. They yield little or no dye, and their commercial value lies mainly in the oil. Whereas the seeds from plants grown for the carthamin dye had only 22—28% of oil, certain varieties recently developed in Australia, in the mid-western states of U.S.A., and in some other countries, have an oil content as high as 38%.[2] Work on the cultivation of such varieties has also been more recently carried out by Messrs. Sind Land Development Farms. Some of the varieties developed in the course of this work have been examined at the Central Laboratories with special reference to the industrial uses of the oil, and the results are given in this paper.

The Content of Oil and its Composition

The oil contents of four varieties of seeds are given in Table 1 and the characteristic constants

TABLE 1

Varieties	Oil content%		Moisture
	Whole seed	Kernel	
Farmseed ..	37.3	62.0	6.0
Fatisa ..	35.3	62.1	6.1
Shambat ..	35.7	63.4	5.3
Debra ..	37.8	62.5	5.5

TABLE 2.—CHARACTERISTICS OF THE OIL.

Characteristics	Variety			
	Farm seed	Fatisa	Shambat	Debra
Specific gravity @ 28°C.	0.9182	0.9183	0.9181	0.9181
Refractive index @ 25°C	1.4727	1.4723	1.4727	1.4725
Viscosity @ 30°C. (centistokes)	42	42	42	42
Acid value	1.9	1.4	4.7	1.9
Saponification value	192	190	196	191
Iodine value (Hanus)	136	142	136	140
Thiocyanogen value	77	78.2	77.3	77.9

TABLE 3.—COMPOSITION OF FATTY ACID GLYCERIDES.

Glyceride	Variety			
	Farmseed	Fatisa	Shambat	Debra
Linoleic glyceride %	68.0	73.6	67.5	71.8
Oleic glyceride %	20.9	16.7	21.6	18.4
Saturated glycerides %	11.1	9.7	10.9	9.8
Saturated glycerides % (Bertram's method) ..	12.2	10.3	11.5	10.7

TABLE 4.—DRYING TIMES (IN HOURS) OF SAFFLOWER OIL FILMS AT 28—30°C.

Drier in oil	Farmseed-shambat			Fatisa-Debra		
	Touch dry	Hard dry	Tack free	Touch dry	Hard dry	Tack free
A. Soluble driers						
0.5% Pb	48	—	—	48	72	—
0.5% Mn	24	36	—	12	16	72
0.25% Mn	36	48	—	14	18	—
0.25% Co	6	24	—	4	16	—
0.3% Pb+0.03% Co	12	18	—	8	14	48
0.3% Pb+0.1% Co ..	7	16	—	4	8	48
0.5% Pb+0.1% Co ..	7	16	—	4	8	36
B. Drier metals cooked in oil						
0.5% Pb	28	60	—	24	36	—
0.5% Mn	14	28	—	9	12	60
0.25% Mn	26	36	—	11	15	—
0.3% Pb+0.1% Co ..	5	12	—	3	6	36
0.5% Pb+0.1% Co ..	5	12	—	3	6	30

The minus sign '—' denotes that the film does not become tack-free.

of the oil in Table 2, while Table 3 shows the composition of the constituent fatty acid glycerides.

The composition of the fatty acids has been determined from the iodine and thiocyanogen values. In these calculations, no unsaturation greater than that of linolenic acid is assumed to be present. The absence of linolenic acid was confirmed by determining the proportion of saturated fatty acids and calculating the percentage of linolenic acid by using the following equation, which gave a negative value.

$$\text{Linolenic acid}\% = 1.5637 \times \text{T. V.} - 0.0780 \times \text{I. V.} + 1.3271 \times \text{S} - 132.71$$

Where T. V. is thiocyanogen value, I. V. is iodine value and S is proportion of saturated fatty acids.

Drying Properties of the Oil

The drying properties of the oils have been studied under the two following conditions:

(a) after addition of liquid driers of known metal concentration, the driers being in the form of stabilised solutions of lead, manganese and cobalt rosinates in white spirit.
(b) with the incorporation of driers obtained by cooking the metallic oxides or acetates into the oil.

Test samples of oil containing the required concentration of driers were painted on glass panels and the time taken for the films to dry to touch, to hard dry, and to become tack-free (all at room temperature) was noted.

For this study, the oils were divided into two batches, the first batch consisting of 'Shambat' and 'Farmseed' varieties, of iodine value 136, and the second batch of 'Debra' and 'Fatisa' varieties, of iodine values 140 and 142 respectively.

The above results show that the drying properties of the oil from 'Fatisa' and 'Debra' varieties are satisfactory with a drier containing 0.5% lead and 0.1% cobalt. With the same driers, 'Farmseed' and 'Shambat' varieties fail to become tack-free, and cannot therefore be used as substitutes for linseed and other drying oils in the manufacture of paints.

TABLE 5.—LOAD IN GRAMS FOR RUPTURING OF FILMS OF OLEO-RESINOUS VARNISHES INCORPORATING (a) SAFFLOWER OIL (b) LINSEED OIL.

Oil length gallons per 100 lbs. resin.	Load in g.	
	Safflower varnish	Linseed varnish
15	280–290	250–260
25	320–330	300–310
35	320–330	310–320

TABLE 6.—WATER RESISTANCE PROPERTIES OF OLEO-RESINOUS VARNISH FILMS.

Oil length (gallons per 100 lbs. resin)	Oil	Time for disappearance of haze after				
		One hr. dip	Two hr. dip	Four hr. dip	24 hr. dip	48 hr. dip
15	Safflower	unaffected	unaffected	unaffected	1—1½ hrs.	6—8 hrs.
	Linseed	,,	,,	,,	2—3 hrs.	10—12 hrs.
25	Safflower	,,	,,	,,	8—10 hrs. slightly affected.	presists after 24 hrs.
	Linseed	,,	,,	20 minutes	persists after 24 hrs.	whiteness, persists after 24 hours.
35	Safflower	,,	10 minutes	30 minutes	persists after 24 hrs.	whiteness, persists after 24 hours.
	Linseed	,,	30 ,,	1 hr. slightly affected.	persists after 24 hrs.	whiteness, persists after 24 hours.

Tests on Oleo-Resinous Varnishes incorporating Safflower Oil

Oleo-resinous varnishes of '15', '25' and '35' gallons oil length have been prepared and their properties compared with corresponding linseed oil varnishes. All the varieties of safflower oil examined have been found to be suitable for this purpose. The loads for rupturing films of the afore-mentioned varnishes on a standard scratch-test apparatus have been determined, and the values are reported in Table 5. The water resistance properties are given in Table 6.

It appears from the two tables that in both series of tests, safflower oil varnishes are slightly superior to those based on linseed oil.

Conclusions

The oil content of the different varieties developed by Messrs. Sind Land Development Farm has been found to compare favourably with the best reported figures in the literature. The present work shows that 'Fatisa' and 'Debra' varieties can be used satisfactorily either as drying oils or for the manufacture of oleo-resinous varnishes. In fact, the performance of the varnishes based on safflower oil is found to be somewhat superior to that for linseed oil varnishes. The extensive cultivation of safflower seed should therefore be seriously considered in view of the non-availability of linseed and other suitable drying oils in the country.

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