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CHEMICAL COMPOSITION, KEEPING QUALITY AND NUTRITIVE VALUE OF SAFFLOWER AND NIGERSEED OILS

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Abstract

1. One variety each of safflower seed and niger seed were examined with respect to chemical composition of the seed, kernel and oil.
2. The stability of crude, refined and bleached safflower seed and niger seed oils was studied both by the A.O.M. test as well as by storing in aluminium and tinned brass containers for a period of three months and following the rate of development of peroxides.
3. The results indicate that safflower seed and niger seed oils are easily susceptible to oxidative rancidity and are not as stable as groundnut oil.
4. No significant difference between the growth promoting value of safflower seed oil, niger seed oil, groundnut oil and cow's ghee was observed.
5. Safflower seed and niger seed oils were found to be almost completely digestible (to the extent of 96-98 per cent) by rat.
6. In the case of young rats fed on an adequate diet containing safflower or niger seed oils at 10 per cent level the retention of nitrogen was about 51 per cent, of calcium 60-62 per cent and of phosphorus 66-67 per cent.

Safflower (*Carthamus tinctorius*) and Niger (*Guizota abyssinica*) have been known as oil seed crops of considerable importance since ancient times. They are cultivated to some extent in many states in India and have attained considerable importance as oil seed crops in Bombay and Mysore states. Both safflower seed oil and niger seed oil are classed as semi drying oils and serve as a vehicle for paints, varnishes and enamels and in the production of oil modified alkyd resins. Various investigators (Vidyarthi 1943; Bickford *et al.*, 1943, Sahasrabudhe and Kale, 1937; Hilditch and Sime, 1944) have reported data for the characteristics and fatty acid composition of safflower seed oil and niger seed oil of various origin. Although the oils have been used for edible purposes for many years, little information is available in literature about their keeping quality and nutritive value. The present paper deals with the composition, stability and nutritive value of crude and refined safflower seed oil and niger seed oil.

Experimental

Preparation and extraction of the seeds:

Healthy safflower and niger seeds obtained from Bombay and Mysore states respectively were first crushed either in a triple roller mill or a meat mincer and then steamed at atmospheric pressure for half an hour, and the oil was then expressed at a pressure of 1·25 tons per sq. in. in a hydraulic press (Laboratory model). The yield of the oil was about 20-25 per cent of the seed. However, considerable oil was lost on account of the presence of hulls along with meats.

The whole seeds and kernels were analysed for proximate principles and minerals according to the methods of A.O.A.C. (1950). The results are given in Table I.

Characteristics and composition of the oils:

The physical and chemical characteristics of the oil were determined according to the official methods of the American Oil Chemists' Society (1946). The saturated fatty acids were determined by the Bertram oxidation method. The glyceride composition of the safflower and niger seed oils was calculated from the thiocyanogen and iodine values. The results of these determinations are given in Tables II and III.

Refining and bleaching:

Crude safflower seed and niger seed oils were refined by official A.O.C.S. (1946) methods for soyabean oil. The refining was normal in all respects except that the soap stock was partly liquid even at 15°C. Losses of 3-3·5 per cent were obtained on refining with 14° Be sodium hydroxide. The colour of refined safflower seed oil was 20 yellow and 1·6 Red Lovibond units, while the colour of refined niger seed oil was 10 yellow and 1·4 Red Lovibond units. Bleaching with 2 per cent fuller's earth gave very light coloured oils.

Stability of crude, refined and bleached safflower seed and nigerseed oils:

The stability of crude, refined and bleached safflower seed and niger seed oils was studied by the active oxygen method (A.O.C.S. 1945). The results are given in Table IV.

To find out the keeping quality of the oils, crude, refined and bleached samples of safflower seed and niger seed oils were stored in aluminium and tinned brass containers both at room temp. and 37°C. Such a procedure was adopted as edible oils are usually stored in aluminium or tinned brass vessels. Groundnut oil was also included in the study for comparison. The peroxide value of the different oils was followed for a period of 3 months. The results are given in Table V.

Nutritive value of safflower seed and niger seed oils:

Studies on the following aspects of the nutritive value of safflower seed and niger seed oils were conducted (i) the growth promoting value (ii) *in vivo* and *in vitro* digestibility and (iii) the effect on nitrogen, calcium and phosphorus metabolism.

Growth promoting value of safflower seed and nigerseed oils:

Groups of freshly weaned rats, about four weeks old, weighing about 40 g. were used in the experiments. Each group contained six rats distributed equally according to sex and litter mates. The different groups were fed on the experimental diets containing safflower seed oil, niger seed oil, groundnut oil and cow's ghee. The composition of the diet is shown in Table VI. In addition to the diet two drops of Adexoline and 2 mg. of alpha-tocopherol were given orally to each rat, twice a week to meet their vitamin A, D & E requirements. The feeding was carried out for a period of 8 weeks. The average weekly increase in weight as well as the increase in weight per gram of fat intake is given in Table VII. No significant difference was observed between the growth promoting value of safflower seed oil, niger seed oil, groundnut oil and cow's ghee.

TABLE I

Composition of safflower seed and niger seed

Constituent	Safflower		Niger	
	Whole seed	Kernel	Whole seed	Kernel
Moisture % ...	6·8	6·5	7·8	6·8
Fat %	27·2	46·8	31·3	49·8
Protein (N x 6·25) % ...	12·53	22·4	19·4	28·1
Ash %	1·68	1·78	1·80	2·80
Calcium %	0·056	0·058	0·05	0·05
Phosphorus % ...	0·25	0·39	0·18	0·26

TABLE II

Characteristics of safflower seed and niger seed oils

Constituent	Safflower seed oil	Niger seed oil
Specific gravity ...	0·921	0·917
Refractive index ...	1·460	1·472
F.F.A. (% oleic) ...	0·45	1·0
Sap. value ...	192·0	188·8
Iodine value ...	130·3	120·5
SCN. value ...	84·0	85·4
Unsaponifiables % ...	0·9	0·6
Saturated acids % ...	6·1	9·2

TABLE III

Glyceride composition of safflower seed and niger seed oils

Fat	Unsaturated	Saturated	Oleic	Linoleic
Safflower seed oil ...	6·4	93·6	36·5	57·1
Niger seed oil	9·5	90·5	37·0	53·5

TABLE IV

Stability of Safflower seed and niger seed oils
(A.O.M. method)

	A.O.M. hours
Crude safflower seed oil	14·5
Refined safflower seed oil	10·5
Refined and bleached safflower seed oil ...	10·0
Crude niger seed oil	11·5
Refined niger seed oil	6·5
Refined and bleached niger seed oil	6·0

TABLE V

Peroxide values of crude, refined and bleached safflower seed and niger seed oils stored at room temp.* (25-30°C) *and* 37°C *at the end of 3 months.*

Fat	Type of container	Peroxide value R.T.	Peroxide value 37°C
Crude safflower seed oil	Aluminium ...	62·8	160·2
	Tinned brass ...	68·4	162·0
Refined safflower seed oil	Aluminium ...	90·7	383·8
	Tinned brass ...	111·0	395·6
Refined and bleached safflower seed oil ...	Aluminium ...	166·3	605·6
	Tinned brass ...	182·6	622·8
Crude niger seed oil	Aluminium ...	78·7	188·4
	Tinned brass ...	46·2	79·6
Refined niger seed oil	Aluminium ...	90·6	515·0
	Tinned brass ...	72·6	143·0
Refined and bleached niger seed oil ...	Aluminium ...	186·4	557·5
	Tinned brass ...	85·8	167·2
Groundnut oil	Aluminium ...	16·0	22·0
	Tinned brass ...	14·0	25·0

* Initial peroxide value of the different oils was zero.

TABLE VI

Percentage composition of experimental diet

Casein (fat free)	12·0
Corn starch	60·0
Sucrose	10·0
Vitaminized starch† ...	4·0
McCollum & Davis salt mixture...	4·0
Fat*	10·0

† Four per cent of vitaminized starch in the diet supplied the daily requirement of all B-group of vitamins.

* The oil or fat included one of the following: Safflower seed oil, niger seed oil, groundnut oil and cow's ghee.

TABLE VII

Comparative rates of growth of rats fed on diets containing different fats

Fat fed*	Average increase in weight per week (g)		Increase in weight per g. of fat intake (g)	
Safflower seed oil ...	12.50	±0·76 (16 d.f.)	1·976	±0·056 (16 d.f.)
Niger seed oil ...	11·85		1·856	
Groundnut oil ...	12·76		2·004	
Cow's ghee ...	12·96		2·06	

* Level of fat in the diet was 10% in all the cases.

TABLE VIII

Digestibility of safflower seed and niger seed oils.

Fat fed	Coefficient of digestibility (%)
Safflower seed oil	98·7
Niger seed oil	95·6
Groundnut oil	98·0
Cow's ghee	98·8

TABLE IX

Effect of safflower seed and niger seed oil on nitrogen, calcium and phosphorus metabolism.

Fat fed	Nitrogen retained %	Calcium retained %	Phosphorus retained %
Nil (fat free diet) ...	49·2	46·8	55·6
Safflower seed oil ...	51·1	60·1	67·1
Groundnut oil ...	50·8	57·2	62·5
Niger seed oil ...	51·9	62·0	66·5
Cow's ghee ...	50·3	55·6	57·6

Digestibility of safflower seed and niger seed oils:

The *in vitro* digestibility of crude safflower seed and niger seed oils was studied using castor seed and pancreatic lipases (Ahmed and Sareen, 1945-46; Weinstein, and Wynne, 1935-36). The course of hydrolysis of safflower seed and niger seed oils was nearly the same as those of other edihle oils like groundnut oil.

The digestibility coefficients of safflower seed and niger seed oils was determined on adult rats by feeding diets containing the different fats at 10 per cent level. The method adopted was similar to that of Narayana Rao and De (1951). The composition of the diet was the same as that given in Table VI. Calculation for digestibility coefficients were made in the usual manner after correction for metabolic fat. The results presented in Table VIII show that all fats tested are almost completely digestible by rats.

Effect of safflower seed oil and nigerseed oil on nitrogen, calcium and phosphorus metabolism in young rats.

The effect of safflower seed and niger seed oil on nitrogen, calcium and phosphorus metabolism in young rats was determined by the metabolism study (Narayana Rao and De 1952). Rats weighing about 40 g. were fed on an adequate diet (Table VI). During the collection period the rats were kept in individual metabolism cages with arrangements for the collection of urine and faeces. After a preliminary period of 7 days on the experimental diet, the faeces and urine were collected for 7 days and analysed for nitrogen, calcium and phosphorus. From the amount of nitrogen, calcium and phosphorus retained in the hody, the effect of different oils on nitrogen, calcium and phosphorus utilization was determined. The results are given in Table IX.

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