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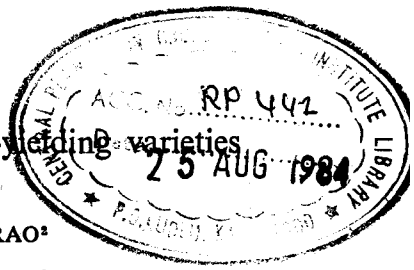


# Chemical composition and fatty acid profile of high-yielding varieties of oilseeds

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## ABSTRACT

High-yielding varieties of groundnut (28), coconut (9), mustard (8), sesame (6) and safflower (6) were analysed for protein, methionine, tryptophan, lysine, nicotinic acid, riboflavin and total vitamin $B_6$ contents. There were no significant differences among the varieties of a given oilseed for any of the constituents analysed. There was a negative correlation between protein and fat as well as protein and lysine in all oilseeds except safflower. This negative correlation was significant only between protein and fat contents of groundnut. There was a positive correlation between protein and methionine content of all oilseeds except groundnut. The high-yielding varieties seemed to have retained their characteristic patern of distribution of fatty acids and other essential nutrients. [Groundnut, *Arachis hypogaea* Linn.; coconut, *Cocos nucifera* Linn.; mustard, *Brassica juncea* (Linn.) Czern. & Coss. subsp. *juncea* Linn.; sesame, *Sesamum indicum* Linn.; safflower, *Carthamus tinctorius* Linn.]

Any attempt at evolving high-yielding varieties of oilseeds is aimed at increasing oil but also protein. Several workers have reported the fat content and component fatty acids of oilseeds (Trehan *et al.*, 1974; Kartha, 1967; Sreenivasan, 1968). The aim of our study was to find out if the high-yielding nature of the recently released varieties of oilseeds has in any way altered the distribution of fatty acids. Hence high-yielding varieties of groundnut (*Arachis hypogaea* Linn.), coconut (*Cocos nucifera* Linn.), mustard [*Brassica juncea* (Linn.) Czern. & Coss. subsp. *juncea* Linn.], sesame (*Sesamum indicum* Linn.) and safflower (*Carthamus tinctorius* Linn.) were analysed for their proximate principles, vitamins, some essential amino acids and complete fatty-acid profile.

## MATERIALS AND METHODS

The samples analysed included 28 varieties of groundnut grown at the Regional Agricultural Research Station, Kadiri, Andhra Pradesh; 9 coconut cultivars obtained from the Central Plantation Crops Research Institute, Kasaragod, Kerala, 8 mustard varieties cultivated at the Haryana Agricultural University, Hissar, Haryana; 6 varieties of sesame grown at Karimnagar, Andhra Pradesh; and 6 safflower varieties obtained from Annigeri, Karnataka.

Protein, fat and ash contents of these oilseeds were determined according to standard methods outlined by the AOAC (1960). For fat extraction of safflower, however, chloroform : methanol extraction was used. Microbiological procedures were followed for assays of vitamins and amino acids (Srinivasa Rao and Ramasastry, 1969). Methanolysis of isolated fat was carried out according to the procedure of Hubshcer *et al.* (1960) and the resulting methyl esters were analysed on GLC, using Wilkens model 650 Aerograf fitted with FID (Srinivasa Rao and Subba Rao, 1973).

## RESULTS AND DISCUSSION

There were no significant differences

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Table 1. Chemical composition

| Oilseed | No. of samples analysed | Moisture | Protein | Fat g/100g | Ash |
|---|---|---|---|---|---|
| Groundnut | 28 | 4.1 ±0.08† | 29.1 ±0.47 | 40.0 ±0.65 | 3.1 ±0.17 |
| CV (%) | | 9.9 | 8.5 | 8.6 | 29.6 |
| Coconut | 9 | 0 | 6.5 ±0.15 | 68.3 ±0.09* | 2.1 ±0.09 |
| CV (%) | | | 6.7 | 4.0 | 12.6 |
| Mustard | 8 | 6.4 ±0.06 | 22.3 ±0.51 | 32.0 ±1.09 | 4.2 ±0.07 |
| CV (%) | | 2.8 | 6.5 | 9.8 | 5.0 |
| Sesame | 6 | 3.3 ±0.05 | 23.9 ±0.54 | 34.9 ±1.50 | 6.8 ±0.15 |
| CV (%) | | 3.8 | 5.5 | 10.6 | 5.2 |
| Safflower | 6 | 3.6 ±0.10 | 16.6 ±0.82 | 28.9 ±1.44 | 1.7 ±0.10 |
| CV (%) | | 6.5 | 12.1 | 12.2 | 5.8 |

†Values given are mean ± SEm.
*Fat expressed on dry weight basis.

Table 2. Correlation coefficients among the nutrients of oilseeds

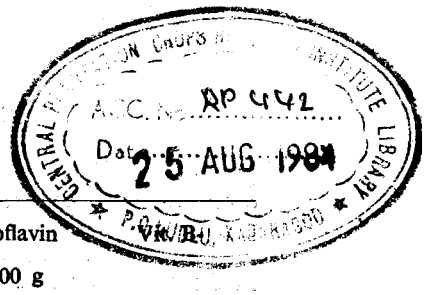
| Oilseed | df | Protein vs fat | Protein vs tryptophan | Protein vs methionine | Protein vs lysine | Tryptophan vs methionine | Tryptophan vs lysine | Methionine vs lysine |
|---|---|---|---|---|---|---|---|---|
| Groundnut | 27 | —0.3903* | 0.4307* | —0.1457 | —0.3038 | —0.0248 | 0.0409 | —0.1504 |
| Coconut | 8 | —0.3193 | 0.5131 | 0.6368* | —0.0694 | 0.5297 | —0.1900 | 0.7616* |
| Mustard | 7 | —0.2225 | —0.7384* | 0.2333 | —0.5068 | —0.6172 | +0.6692* | —0.4188 |
| Sesame | 5 | —0.5279 | 0.5130 | 0.0167 | —0.2158 | 0.6030 | —0.7071 | +0.6929 |
| Safflower | 5 | 0.1273 | —0.0257 | 0.6536 | 0.0270 | —0.1581 | 0.6237 | —0.2907 |

*$P < 0.005$.

Table 3. Fatty acid composition

| Oilseed | No. of varieties | Total fat g/100 g | Percentage of total methyl esters | | | | |
|---|---|---|---|---|---|---|---|
| | | | Saturated fatty acids | | | | |
| | | | Palmitic C 16:0 | Stearic C 18:0 | Arachidic C 20:0 | Behenic C 22:0 | Lignoceric C 24:0 |
| Groundnut | 27 | 40.0 ±0.65 (31.0 –45.1) | 12.6± 0.87 (9.0 –24.9) | 1.7± 0.24 (tr – 5.5) | 4.2± 0.48 (2.0 –10.2) | 2.1± 0.16 (0.7 –3.9) | 0.3±0.13 (tr–2.8) |
| Sesame | 6 | 34.9 ±1.5 (29.9 –40.3) | 9.7± 0.81 (8.7 – 9.9) | 3.4± 0.64 (2.5 – 6.9) | — | — | — |
| Safflower | 6 | 28.9 ±1.46 (24.2 –33.9) | 6.6± 0.97 (3.6 –10.0) | 1.2± 0.17 (0.7 – 1.1) | — | — | — |
| Mustard | 8 | 32.0 ±1.09 (26.5 –36.5) | 2.9± 0.17 (2.3 – 3.5) | 0.9± 0.04 (0.7 – 1.1) | | — | — |
| Coconut | 9 | 68.3 ±0.92** (64.4 –70.9) | 7.8± 0.36 (6.6 –10.2) | 2.3± 0.21 (0.4 – 3.5) | — | — | — |

*Includes also lower fatty acids in significant amount, vix. caprylic (C 8:0) 6.0±0.71, range myristic (C 14:0) 18.4±0.98, range 13.6–24.6.
**Expressed on dry-weight basis. All values are mean ± SEm; values in parentheses indicate




of oilseeds

| Tryptophan | Methionine | Lysine | Nicotinic acid | Riboflavin | Vit. B6 |
|---|---|---|---|---|---|
| | g/16 N | | | mg/100 g | |
| 0.7 ±0.01 | 1.0 ±0.01 | 3.1 ±0.06 | 17.5 ±0.052 | 0.09±0.002 | 0.65±0.016 |
| 8.4 | 7.2 | 9.9 | 15.8 | 10.7 | 12.8 |
| 0.6 ±0.02 | 1.8 ±0.07 | 3.4 ±0.10 | 1.1 ±0.07 | 0.04±0.008 | 0.09±0.006 |
| 8.1 | 11.1 | 9.3 | 18.2 | 6.1 | 20.7 |
| 0.5 ±0.02 | 2.0 ±0.05 | 4.8 ±0.09 | 5.1 ±0.16 | 0.20±0.004 | 0.54±0.031 |
| 14.1 | 6.5 | 5.4 | 9.1 | 5.4 | 16.1 |
| 0.8 ±0.02 | 2.1 ±0.05 | 3.0 ±0.04 | 6.0 ±0.29 | 0.28±0.014 | 0.79±0.030 |
| 7.3 | 5.8 | 3.4 | 11.7 | 12.3 | 9.4 |
| 0.8 ±0.04 | 1.7 ±0.02 | 1.8 ±0.06 | 0.8 ±0.06 | 0.06 ±0.004 | 0.27±0.016 |
| 13.4 | 2.4 | 21.8 | 18.8 | 19.1 | 14.9 |

in any of the constituents among the varieties of a given oilseed (Table 1) except in the ash content of groundnut (% CV 29.6). Most of the parameters varied from one oilseed type to the other. The values observed were within the range of values reported by others workers.

Mustard had the highest moisture content and sesame the lowest. Coconut had the highest and safflower the lowest fat content. The protein content was the highest in groundnut and lowest in coconut. A negative correlation appeared to exist between protein and fat contents of all the oilseeds e xcept safflower (Table 2). This correlation was significant only in groundnut (r = —0.3903).

There were significant differences in the mineral content of groundnut varieties. Sesame varieties had a high mineral matter (6.8 g%) while safflower varieties had the least (1.7 g%) among the oilseeds analysed.

Mustard protein seemed to be deficient in tryptophan. There was a significant positive correlation between protein and tryptophan content in groundnut varieties

of oilseeds

of fatty acids

| Total saturated | Monounsaturated | | | | Polyunsaturated | | Total unsaturated | Others |
|---|---|---|---|---|---|---|---|---|
| | Palmitoleic C 16:1 | Oleic C 18:1 | Eicosenoic acid 20:1 | Erucic C 22:1 | Linoleic C 18:2 | Linolenic C 18:3 | | |
| 20.9 | 1.4 0.17 (0.6 - 3.3) | 47.9± 0.97 (38.7 –56.2) | — | — | 29.9± 0.08 (16.2 –38.4) | — | 79.1 | — |
| 13.1 | 0.08± 0.24 (tr - 1.5) | 41.2± 0.94 (38.9– 45.1) | — | — | 44.5± 1.05 (40.9 –47.5) | — | 86.5 | — |
| 7.8 | — | 13.7± 1.08 (10.1 –18.1) | — | — | 78.5± 1.4 (74.8 –83.0) | — | 92.2 | — |
| 10.7 | 0.6± 0.03 (0.4 - 0.7) | 8.9± 0.44 (7.8 –11.6) | 6.9± 0.44 (6.6 - 9.3) | 46.5± 0.84 (42.1 –49.6) | 18.1± 0.69 (15.7 –20.9) | 14.5± 0.65 (11.9 –17.5) | 88.6 | 0.75± ±0.11 |
| 93.1* | — | 7.8± 0.38 (6.6 - 9.9) | — | — | 0.8± 0.10 (0.4 - 1.2) | — | 8.6 | — |

2.7–10; capric (C 10:0) 6.5±0.38, range 5.8–8.8; lauric (C 12:0) 52.1±2.01, range 39.1–62.1;

range between varieties.

($r = +0.4307$), while a significant negative correlation was observed for mustard varities ($r = -0.7384$).

Groundnut varieties had the lowest methionine content among the 5 oilseeds. There was a positive correlation between protein and methionine content in all oilseeds except groundnut. But this correlation was significant only in coconut.

Mustard varieties were richer in lysine content (4.8 g/16 g N) and safflower varieties were poorer in this amino acid content (1.8 g/16 g N). There was a significant positive correlation between lysine and tryptophan in mustard ($r = +0.6692$), and between lysine and methionine in coconut ($r = +0.7616$.

Mustard protein was deficient in tryptophan, methionine was more limiting in groundnut protein, and lysine in safflower protein. Sesame protein appeared to be better balanced in essential amino acids.

Nicotinic acid was predominantly concentrated in groundnut. Sesame seeds showed highest content of riboflavin and total vitamin $B_6$.

The values for protein, methionine and nicotinic acid observed by us were similar to those reported by Cheema and Ranhotra (1967, 1968). The protein, fat and ash contents of groundnut, sesame and safflower in our study were comparable to those reported by Bharambe and Badhe (1976). Abidi (1976) reported lower values for methionine in sesame seeds.

The distribution pattern of fatty acids in oils from different oilseeds is shown in Table 3. The saturated fatty acids in coconut oil amounted to 93%. They mostly comprised lower-chain fatty acids like caprylic (8:0), capric (10:0), lauric (12:0) and myristic (14:0) acids. Coconut oil contained least amounts of linoleic acid.

Safflower oil contained highest proportion of unsaturated fatty acids (92%) of which linoleic acid (18:2) constituted 78.5%, the range being 75 and 83% in different varieties.

Groundnut and sesame varieties had fairly high concentration of linoleic acid. But oleic acid was the major unsaturated fatty acid in groundnut, and linoleic predominated in sesame.

Mustard contained the major unusual unsaturated fatty acid erucic acid (22.1), its range being 42 and 49%. The extent of linoleic acid and linolenic acid was 18.2% and 14.5% respectively.

The mean values for various fatty acids were comparable with the values of American origin (USDA, 1979). Kartha (1967, 1972) indicated changes in component fatty acids due to variety and as a result of seed maturity. But the high-yielding nature of the recently released varieties studied by us did not seem to influence distribution pattern of these lipid constituents.

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