Amino and Fatty Acid Composition of *Pentaclethra macrophylla* and *Treculia africana* Seeds

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ABSTRACT

Two tropical oilseeds, *Pentaclethra macrophylla* and *Treculia africana*, are rich sources of edible well-balanced protein and the essential fatty acid, linoleic acid.

INTRODUCTION

Pentaclethra macrophylla and *Treculia africana* are tropican oilseed trees which grow wild in Eastern Nigeria. *T. africana* seeds are parboiled, dehulled, threshed, cooked and eaten either with meat stew or after mashing with cooked corn, palm oil and vegetables. Dehulled *P. macrophylla* seeds are cooked, sliced into thin strips, soaked in water overnight, washed several times and covered with banana leaves. They ferment for 2-3 days at ambient temperatures, then are mixed with palm oil, spiced and eaten with cooked cassava chips or roasted yams (*Dioscorea spp.*).

Although these oilseeds constitute a cheap source of protein and calories for some 14 million people in Nigeria, their agronomy has not received systematic study. In the face of dwindling raw materials and food supplies from familiar sources, renewed international interest exists in studying neglected plants with promising economic and food value (1).

This paper presents data on the fatty acid and amino acid composition of *P. macrophylla* and *T. africana* seeds.

EXPERIMENTAL PROCEDURES

Materials

P. Macrophylla and *T. africana* seeds were purchased from local markets in Eastern Nigeria. All solvents and reagents used were of analytical grade.

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Methods

Oil was extracted with hexane from ground, dehulled seeds. Fatty acid methyl esters were obtained quanitatively by direct transesterification with methanolic potassium hydroxide at room temperature (2). The esters were analyzed at 190 C on a Hewlett-Packard HP Research Gas Chromatograph Model 7260A using a 10 ft x ¼ in. (od) aluminium column packed with 60/80 mesh Chromosorb W coated with 15% bisethyleneglycol succinate polyester (DEGS). The separated esters were identified by comparing their relative retention times with those of known standards and using the usual semilog plot of relative retention value vs equivalent chain length with methyl heptadecanoate as the internal standard. The identity of the unsaturated acids was further established by GLC analysis of brominated and hydrogenated samples (3). The identified fatty acids were quantitated by multiplying peak areas by the appropriate response factors previously obtained with known reference mixtures (4).

The defatted meals were analyzed for protein by the micro-Kjeldahl method (5). For the determination of total amino acids, ca. 200 mg of defatted meal was carefully hydrolyzed under nitrogen with 450 ml 6 N HCL at 120 C for 20 hr. After vacuum evaporation, the amino acid mixture was dissolved in 0.1 M citrate-phosphate buffer (pH 2.2) containing 0.1 mol of nor-leucine/ml. Amino acids were determined on a Yanangimoto Auto Analyser Model LC-5.

RESULTS AND DISCUSSION

Both oilseeds were rich in protein (48 and 22% of the meal of *P. macrophylla* and *T. africana*, respectively) but additional work is needed to determine the quality of these proteins. Table I shows that, except for low values of

TABLE I

Amino Acid Content of *P. macrophylla* and *T. africana* Seeds (g/100 g protein)

Amino acid	*P. macrophylla*	*T. africana*	FAO reference protein[a]
Aspartic acid	9.06	9.03	–
Threonine	4.17	4.94	2.8
Serine	5.54	5.77	–
Glutamic acid	9.32	9.32	–
Proline	5.77	3.58	–
Glycine	4.62	6.68	–
Alanine	4.34	3.67	–
Cysteine	1.83	0.77	2.0
Valine	6.60	6.15	4.2
Methionine	1.23	1.84	2.2
Isoleucine	4.88	5.93	4.2
Leucine	6.68	6.41	4.8
Tyrosine	5.58	5.52	2.8
Phenylalanine	6.44	5.72	2.8
Lysine	6.97	5.09	4.2
Histidine	2.44	2.45	–
Arginine	6.53	6.61	–
Tryptophan	1.15	2.18	1.4

[a]See ref. 6.

TABLE II

Fatty Acid Composition of the Oil[a] Extracted from *P. macrophylla* and *T. africana* Seeds (% by wt)

Fatty acid	*P. macrophylla*	*T. africana*
Lauric	0.48	–
Myristic	trace	trace
Palmitic	5.2	19.2
Palmitoleic	–	0.58
Stearic	1.8	9.8
Oleic	15.6	13.1
Linoleic	73	44
Linolenic	3.9	13.2

[a]The extracted oils accounted for 31 and 36% of the dehulled *P. macrophylla* and *T. africana* seeds, respectively.

cysteine and methionine, the proteins were fairly rich in essential amino acids and could in fact be considered as good as, if not superior, to the FAO reference protein (6,7).

Table II shows the results of the fatty acid composition analysis. The oils extracted from these seeds were high in the principal essential fatty acid, linoleic acid. Both oils were, however, low in the other essential fatty acid, linolenic, and *P. macrophylla* contained substantially less of this acid than *T. africana.*

Arachidonic acid was not found in the oils. In man, arachidonic acid is synthesized from linoleic acid, so the absence of arachidonic acid would not constitute a nutritional disadvantage. With linoleic and linolenic acids together making up almost 80 and 60% of all the fatty acids in *P. macrophylla* and *T. africana* seed oils, respectively, the potential for the use of these oils as drying oils in the manufacture of paints and varnishes should be investigated. Work on the physicochemical properties of these oils is in progress.

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Biological Evaluation of Hydrogenated Rapeseed Oil

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ABSTRACT

A 91-day feeding study evaluated soybean oil, rapeseed oil, fully hydrogenated soybean oil, fully hydrogenated rapeseed oil, fully hydrogenated superglycerinated soybean oil and fully hydrogenated superglycerinated rapeseed oil at 7.5% of the diet in rats; a 16-wk feeding study evaluated soybean oil and the three rapeseed oils or fats at 15% of the diet. Each fat was fed to 40 rats as a mixture with soybean oil making up 20% of a semi-synthetic diet. No significant differences in body weight gains or diet-related pathology were seen in the 91-day study although the rats fed liquid rapeseed oil had slightly heavier hearts, kidneys and testes than the others. The rats fed the four fully hydrogenated fats ate more feed and had lower feed efficiencies than those fed oils but no differences were seen among the four hydrogenated fats. In the 16-wk feeding study, no pronounced pathology related to the diet was seen although the rats fed liquid rapeseed oil had a slightly higher incidence of histiocytic infiltration of cardiac muscle than the rats in the other groups. The female rats fed the three rapeseed oil fats gained significantly less weight and the females fed liquid rapeseed oil had enlarged hearts compared to the other groups. The absorbabilities of the six fats were measured in the 91-day study when fed as a mixture with soybean oil and as the sole source of dietary fat in a separate 15-day balance study. The four fully hydrogenated fats were poorly absorbed and the absorption of behenic acid from the two hydrogenated rapeseed oils was found to be 12% and 17% in the balance study and 8-40% in the feeding study. The adverse biological effects of unhydrogenated rapeseed oil containing erucic acid as reported in the literature do not occur with fully hydrogenated rapeseed oil. In addition, the low absorbability of the fully hydrogenated rapeseed oil is an added factor in its biological inertness.

INTRODUCTION

Fully hydrogenated rapeseed oil (iv 8) may be used as a stabilizer in peanut butter (1). It normally is used at 1% or less for this purpose. The safety of hydrogenated vegetable oils has been widely recognized. However, the safety of hydrogenated rapeseed oil was questioned because of the recognized hazards associated with the ingestion of unhydrogenated rapeseed oil by laboratory animals.

It has been known for a number of years that rapeseed oil as the sole source of dietary fat will not support a normal rate of growth in the rat. Thomasson and Boldingh (2) demonstrated that this was due to the erucic acid content of the rapeseed oil. In 1960, Roine (3) observed a myocarditis in rats fed 50-70% of their daily calories as rapeseed oil. Subsequently, other workers in Canada and Europe reported similar observations (4,5). The myocarditis, which is characterized by lipidosis in young animals and fibrosis in older animals, was attributed to the erucic acid that comprises 20-55% of the fatty acids of rapeseed oil. The effects of the erucic acid, however, are mitigated by the addition of saturated fatty acids to the diet (6,7).

Because hydrogenation of rapeseed oil converts the