Analysis of *Sesamum indicum* Seed Oil from Plants Grown in Flyash Amended Acidic Soil

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In the present work, flyash amended acidic soil along with plant hormones like gibberellic acid and indole acetic acid were used to increase crop yield and oil-contents, avoiding the aluminium ion toxicity, which might have affected the quality and the medicinal values of sesame seed oil. The seed and oil quality parameters from plants grown in plain and flyash, hormone treated soils were compared after pot experiments.

Key Words: Analysis, Sesame seed oil, Flyash, Soil.

INTRODUCTION

Soil of Chhattisgarh State is acidic or acid prone[1]. In acidic soils the availability of aluminium ions to the plants increases markedly. Aluminium ion toxicity is a major cause of crop failure[2]. Aluminium ion toxicity reduces uptake of phosphorus. Condition is aggravated by low phosphorus status[3]. Other two important effects of soil acidity are manganese toxicity and reduced supply of calcium[4].

EXPERIMENTAL

2 kg sesamum seeds each from plain and flyash treated soil (*i.e.*, from plants grown in flyash 30% + soil 70% + NPK + gibberellic acid and indole acetic acid) were roasted, ground and extracted with petroleum ether in a soxhlet extractor for 15 h. After removal of solvent under reduced pressure, the petroleum ether extract was kept in the refrigerator overnight. Light yellow coloured deposit obtained was filtered. The physicochemical constants were compared as described in Table-1.

TABLE-1
PHYSICOCHEMICAL PROPERTIES OF SESAME SEED OIL

S.No.	Physicochemical properties	A (in plain soil)	B (in flyash treated soil)
1.	Specific gravity	0.812	0.955
2.	Optical rotation	0.96	1.25
3.	Acid value	2.5	3.58
4.	Saponification value	189	195
5.	Iodine value	105	115
6.	Unsaponifiable matter	1.90	4.57

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Seeds from plants grown in flyash and hormones treated soil were high in yield. Oils obtained gave better physicochemical properties. So this oil was studied in detail.

This oil was saponified with alcoholic potash for 2.5 h. Excess of alcohol was distilled off. Soap formed was dissolved in water and shaken with ether in a separating funnel in order to remove the unsaponifiable matter. The fatty acids were liberated from the soap solution by the addition of conc. H_2SO_4 and extracted with ether. The excess of acid was removed by washing the ethereal layer and dried over anhydrous $CaCl_2$. The ethereal layer was distilled to obtain the mixed fatty acids. The fatty acids were separated into solid and liquid fatty acids by Twitchells lead salt alcohol process[5] as modified by Hilditch's method[6].

TABLE-2
PAPER CHROMATOGRAPHIC R_f VALUES OF HIGHER FATTY ACIDS AND THEIR DERIVATIVES OBTAINED FROM SESAME SEED OIL[7]

S.No.	Fatty acids	Derivatives					
		Hydroxamates	2,4-DNPH	Free acids	$Hg(CH_3COO)_2$ addition compound		
		I	II	III	IV	V	VI
1.	Oleic Acid	0.35	—	0.45	0.18	0.20	0.62
2.	Linoleic acid	—	—	0.50	0.57	0.62	0.82
3.	Stearic acid	0.24	0.17	0.29	—	—	—
4.	Palmitic acid	0.30	0.24	0.39	—	—	—
5.	Myristic acid	0.35	0.33	0.55	—	—	—

List of solvents used:

1. Ethyl acetate : THF : water = 0.6 : 3.5 : 4.7 (v/v/v)
2. Methanol : decalon = 8 : 1 (v/v)
3. 25% ethanol, paper impregnated with 12% olive oil in toluene.
4. 90% Methanol : acetic acid : tetralin = 60 : 20 : 11 (v/v/v)
5. Diethylene glycol : acetic acid : tetralin = 60 : 20 : 11 (v/v/v)
6. Methanol : acetic acid : petroleum = 30 : 1 : 7 (v/v/v)

Colour and fluorescence shown by the fatty acids

When the chromatogram is treated successively with phenylhydrazine, rhodamine B and aqueous $AgNO_3$, the following characteristic colours were obtained:

1. Oleic acid gave red brown colour.
2. Linoleic acid gave intense red colour.
3. Stearic acid gave faint red brown colour.

Quinine and flurol G gave different fluorescence as:

1. Oleic acid gave blue fluorescence.
2. Linoleic acid gave intense green fluorescence.

GLC of the mixed fatty acids of sesame seed oil

The mixed fatty acids were converted into their methyl esters by refluxing with anhydrous methanol containing conc. H_2SO_4. A quantitative examination of the fatty acids was done by gas liquid chromatography (GLC) using their methanol esters.

GLC Conditions

1. Column: 10% diethylene glycol on chromosorb Pro W. (60–80 mesh).
2. Detector: Flame ionisation detector.
3. Carrier gas: Nitrogen.
4. Flow rate: 35 mL/min.
5. Chart speed: 1 cm/min.

The peaks were identified by comparing the retention values of peaks with those of pure components and their quantitative studies by calculating the various signal areas (Fig. 1)

Details are given in Table-3 below:

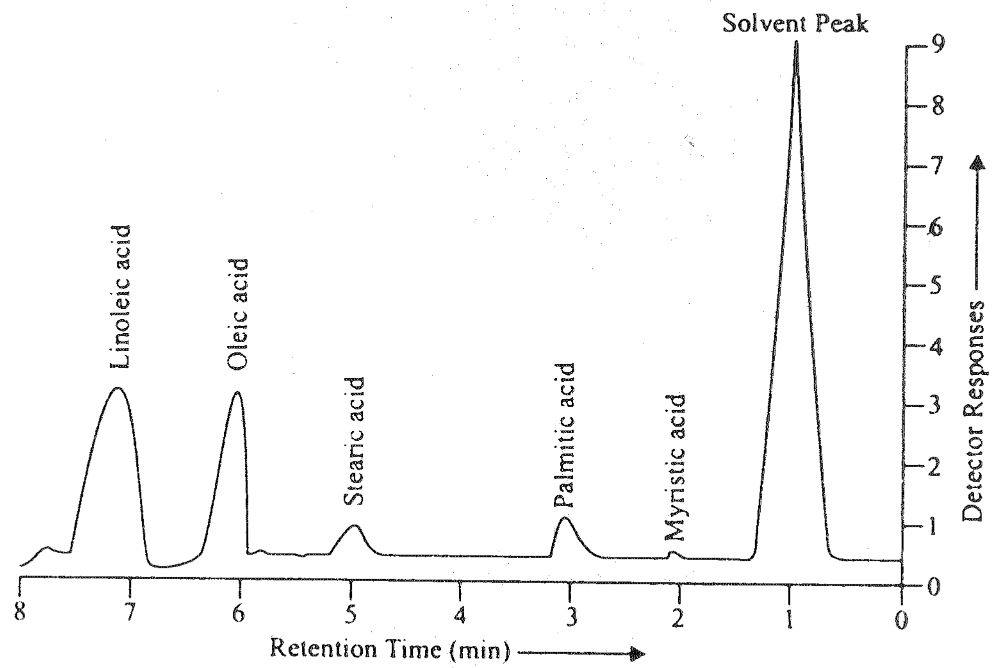

Fig. 1. Gas-liquid chromatogram of methyl esters of fatty acids of sesame oil

TABLE-3
PERCENTAGE COMPOSITION OF FATTY ACIDS IN SESAME SEED OIL

S.No.	Fatty acid	% Composition
1.	Oleic acid	38.5%
2.	Linoleic acid	46.0%
3.	Stearic acid	5.0%
4.	Palmitic acid	9.0%
5.	Myristic acid	0.8%

RESULTS AND DISCUSSION

In the present work, sesame plant roots increase after flyash and hormones treatment of the soil due to reduction in aluminium ion toxicity (Fig. 2) in the pot experiments.

In the present work better crop yield, oil contents and components with medicinal values can be attributed to increase in protease, amylase and invertase activities of soil along with soil respiration[8].

The use of plant hormones is made to regulate biochemical processes by acting upon specific enzymes. Auxin (IAA) increases amino acid uptake and RNA

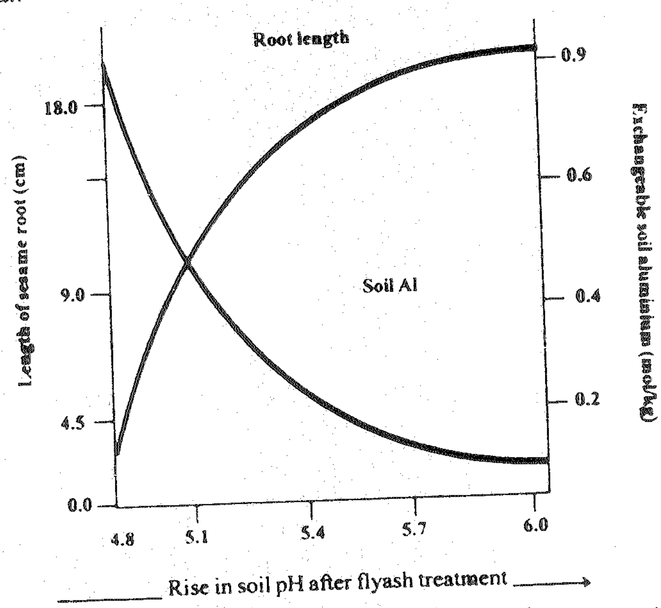

Fig. 2. Increase in root length with decreasing aluminium ion concentration after liming in sesame root after pot experiments

synthesis. Giberellic acid increases protein synthesis and prevents leafsenescence[9]. Ca from flyash helps auxin induced cell elongation[10]. Experiments showed higher percentage of oleic and linoleic acids. It showed positive optical rotation which is unusual of oil devoid of optically active fatty acid glycerides. It has high percentage of unsaponifiable matter, containing components, conferring the oil a higher degree of resistance to oxidative rancidity. According to some authors, roasted sesame seed lignins suppress senescence as well[11].

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