J. Indian bot. Soc. 62 : 48—53, 1983

EFFECT OF SEED BORNE FUNGI ON THE PHYSICO-CHEMICAL PROPERTIES OF SESAMUM SEED OIL[1]

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ABSTRACT

Role of seed-borne fungi on the physico-chemical properties of sesamum oil was studied by infesting the seeds with *Aspergillus flavus* Link, *Alternaria alternata* (Fr.) Keissler and *Drechslera hawaiiensis* M. B. Ellis individually. Color, refractive index, free fatty acids, saponification and iodine values of the extracted oil from the infested seeds were examined. Color changed considerably and free fatty acids and saponification values increased. Iodine value, however, decreased in oils of the seeds infested with *A. flavus* and *D. hawaiiensis*, but increased by infestation with *Alternaria alternata*.

INTRODUCTION

Fats and oils are necessary life sustaining ingredients of human diet. The calorific value of fat is twice that of protein and carbohydrate. Sesamum seeds contain about 45-50% oil which has several industrial uses. Fungal association and invasion of seeds bringing about physical and chemical changes in the oil contents of the seeds have been reported by several workers (Christensen, 1957; Christensen and Kaufmann, 1965, 1969; Diener, 1958; Ward and Diener, 1961 and Tomlins and Townsend, 1968). Agarwal (1965), Eggins and Coursey (1968), Lindsey (1970), Lalithakumari *et al.* (1971) and sharma (1973) have also observed the effect of different fungi on physico-chemical properties of different oil seeds. In the present study effect of *Aspergillus flavus, Alternaria alternata* and *Drechslera hawaiiensis* found to be frequently occurring on sesamum seeds has been undertaken.

MATERIALS AND METHODS

20 gm of sesamum seeds were autoclaved for 20 minutes at 10 lbs pressure. The autoclaved seeds were infested with *Aspergillus flavus* Link, *Alternaria alternata* (Fr.) Keissler and *Drechslera hawaiiensis* M. B. Ellis individually and left at room temperature (Ward and Diener, 1961). Control was maintained without infesting the seed. Oil was extracted from the infested and control seeds after 15 and 30 days of incubation. Extraction of oil was done by petroleum ether (60-80°C) in soxhlet's apparatus for eighteen hours (Meara, 1955).

Colour of the oil was visually recorded. Abbe's refractometer was used for reading the refractive index of the oil (A. O. A. C., 1960). The free fatty acid content of the oil was assessed by boiling the oil with mixture of neutral alcohol and light petroleum (Meara, 1955). Saponification value was determined by the methods outlined by Meara (1955)

1. Accepted for publication on May 6, 1982.

Authors are thankful to Professor K. S. Bilgrami for providing necessary laboratory facilities and to U.G.C. for giving financial assistance

using alcoholic potash which was titrated against 0.5 (N) HCl using phenolphthelein as indicator. Iodine value of the oil was assessed by the Wijs method (Meara, 1955).

RESULTS

Table 1 A evinces the reduction in oil content of the seeds as a result of the infesting test fungi. A considerable amount of decrease in the oil content of the seed was caused by *Aspergillus flavus* and *Alternaria alternata* whereas *Drechslera hawaiiensis* caused the minimum reduction.

However, Refractive index was increased both by *Aspergillus flavus* and *Drechslera hawaiiensis* but *Alternaria alternata* brought about a decrease (Table-1B).

Colour of oil extracted from *Aspergillus flavus* infested seeds changed from yellow to reddish within 15 days of incubation, from yellow to red in *Alternaria alternata* infested seeds in 15days and from yellow to light red in 15 days to deep red in 30 days due to *Drechslera hawaiiensis* infestation (Table Ic).

Regarding the free fatty acids all the three fungi brought about an increase. Maximum increase was by *Alternaria alternata* followed by *Aspergillus flavus* and *Drechslera hawaiiensis* (Table-1D).

In the sapnification value the maximum increase was caused by *Aspergillus flavus*. *Alternaria alternata* and *Drechslera hawaiinsis* resulted in a comparatively lower increase in saponification value (Table-1 E).

Rapid decrease in iodine value was caused by *Aspergillus flavus* and *Drechslera hawaiiensis*.

However, *Alternaria alternata* was reverse in its action and ultimately brought about an increase (Table 1 F).

TABLE I

SHOWING CHANGES IN PHYSICO-CHEMICAL PROPERTIES OF SESAMUM SEED OIL DUE TO FUNGAL INFESTATION

A. CHANGES IN OIL CONTENT

Fungi	0 Day	15 Days		30 Days	
	% oil	% oil	% increase (+) or decrease (—) over control	% oil	% increase (+) or decrease (—) over control
Aspergillus flavus		35.5	—18.39	28.43	—34.64
Alternaria alternata		36.66	—15.72	34.23	—21.31
Drechslera hawaiiensis		41.5	— 4.6	39.2	— 9.89
Control	43.5	41.25	— 5.17	43.33	0.39

B. CHANGES IN REFRACTIVE INDEX

Fungi	0 Days	15 Dyas	30 Days
Aspergillus flavus		1.472	1.476
Alternaria alternata		1.471	1.471
Drechslera hawaiiensis		1.475	1.478
Control	1.473	1.474	1.473

Table I—(Contd.)

C. Changes in colour of the oil

Aspergillus flavus		Yellowish red	Yellowish red
Alternaria alternata		Deep red	Deep red
Drechslera hawaiiensis		Light red	Red
Control	Yellow	Yellow	Yellow

D. Changes in free fatty acid contents

Fungi	0 Day	15 Days		30 Days	
	% free fatty acid	% free fatty acid	% increase (+) or decrease (—) over control	% free fatty acid	% increase (+) or decrease (—) over control
Aspergillus flavus		56.04	1785.64	53.96	1715.8
Alternaria alternata		60.11	1922.58	67.98	2187.42
Drechslera hawaiiensis		18.16	511.09	31.13	947.58
Control	2.97	4.26	43.51	3.93	32.13

E. Changes in saponification value

Fungi	0 Day	15 Days		30 Days	
	Sap. value	Sap. value	% increase (+) or decrease (—) over control	Sap. value	% increase (+) or decrease (—) over control
Aspergillus flavus		194.55	12.01	205.24	16.44
Alternaria alternata		189.84	9.3	197.63	13.78
Drechslera hawaiiensis		169.65	— 2.33	181.76	4.65
Control	173.68	174.46	9.44	172.34	— 0.77

F. Changes in Iodine value

Fungi	0 Day	15 Days		30 Days	
	Iodine	Iodine	% increase (+) or decrease (—) over control	Iodine value	% increase (+) or decrease (—) over control
Aspergillus flavus		114.75	—2.72	104.16	—11.7
Alternaria alternata		116.33	—1.39	119.05	0.91
Drechslera hawaiiensis		114.26	—3.15	108.95	— 7.64
Control	117.97	118.12	0.13	119.15	1.00

All the data were subjected to statistical analysis. Significant results were exhibited in free fatty acid and saponification value. Results of oil reduction, refractive index and iodine value did not show significant effects.

DISCUSSION

All the three seed-borne fungi were able to bring about a considerable reduction in the oil contents of sesamum seeds but statistically insignificant, which might be due to the differential nature of micro-organisms in utilizing the seed substrates. This might also be due to different lipolytic activity of the different seed-borne fungi (Nagel and Semeniuk, 1947) and to the capacity of accumulation of reducing sugar (Vidhyasekaran and Govindaswamy, 1968). Selective utilization of protein in preference to oil (Pattinson and Thornton, 1965) might also explain this behaviour. Ward and Diener (1961), Lalithakumari *et al.* (1971), Sharma (1972) and Singh and Prasad (1977) also reported the variable capacity of different fungal organisms in bringing about the loss.

Changes in colour of the oil might be due to the synthesis of pigments by the invading fungi (Ward and Diener, 1961) or by the oxidation of fat as reported by many previous workers. Either or both of these factors might be considered responsible for the change in the colour of the oil. Lalithakumari *et al.* (1971) and Singh and Prasad (1977) also have recorded the change in oil colour due to fungal invasion.

The results of refractive index is also statistically significant which might be said to be due to the compensatory effect of the two sets of fungi. While on the one hand *Aspergillus flavus* and *Drechslera hawaiiensis* increased the refractive index. *Alternaria alternata* decreased it. The sum total of these two effects might have resulted in statistically insignificant effect. However, individually they have got their own actions of either increasing or decreasing the refractive index. Increase in refractive index reflects the presence of more number of saturated fatty acids. This has also been reported by Sahasrabudhe and Kale (1933) and Milner (1950).

Increase in free fatty acids in infested seeds might be said to be due to the enzymatic activity of these fungi. Lipase possibly hydrolyzes the glycerides and increases the percentage of free fatty acids. Similar experiences were those of Stansbury (1947), Ward (1955) and Wilson (1947). Variations in free fatty acid production might be due to the varying capacity of micro-organisms to produce the amount of lipase and to differential utilization of hydrolytic products of triglycerides. In case of sesamum seed oil, decrease in free fatty acid content was observed due to *A. flavus* in the later phase of incubation which could be explained to be on account of the active utilization of free fatty acid by these organisms. Agarwal (1965) also reported appreciable reduction in free fatty acid contents.

Saponification value of oils of sesamum seeds increased on being infested with different fungi. The increase was proportional directly to the duration of incubation. Increase in saponification value indicates the formation of short chain fatty acids and their glycerides (Shankaran, 1966). Lalithakumari *et al.* (1971), in groundnut seed oil, and Sharma (1973), in cotton and sesamum seeds have reported increase in saponification value. Much increase in saponification value suggests the production of large amount of short chain fatty glycerides which are determining factors for the saponification of oil or fat.

Increase or decrease in iodine value respectively indicate the proportional increase of unsaturated and saturated fatty acids present in the glycerides. The decrease is due to *Aspergillus flavus* and *Drechslera hawaiiensis* while the increase is due to *Alternaria alternata*. Individually the various fungi have either the increasing or the decreasing effects, but the combined effect becomes non-significant possibly on account of the revise nature of actions.

Milner (1950) also noted a decrease in iodine value in soybean whereas Ward and Diener (1961) (in peanut seeds oil) and Sharma (1973) (in cotton seed oil) reported an increase in its value. Knowles (1965) also reported an increase in iodine value in saffiower oil which he suggested to be due to difference in levels of oleic and linoleic acids. Increase in iodine value was thus due to increase in linoleic acids. Lowering of iodine value might be assigned to the oxidation of the oil with the formation of the oxy-acids.

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