

Extraction and Utilization of *Nigella Sativa* L. Oil in Development of Value Added Cookies

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Abstract: The oil extracted by petroleum ether as solvent yield (33.0 per cent) more oil as compare to acetone as solvent. Value added cookies were prepared using *Nigella Sativa* L. oil as a Nutraceutical. Developed product was analysed for sensorial attribute, physical and nutritional quality. The findings revealed that as concentration of oil increased the organoleptic score get decreased to unacceptability due to its specific taste hence the 6 % fortification was possible to produced value added cookies with acceptance. Nutritional analysis revealed that fat content was slightly higher as compared to control sample and other constituent are approximately similar.

Key words: *Nigella Sativa* L., Cookies, Nutraceutical.

I. INTRODUCTION

The black cumin seed belongs to the *Ranunculaceae* family of flowering plants and genus of about 14 species including *Nigella arvensis*, *Nigella ciliaris*, *Nigella damascene*, *Nigella hispanica*, *Nigella integrifolia*, *Nigella nigellastrum*, *Nigella orientalis* and *Nigella sativa*. Among these, *Nigella sativa* is the species most exhaustively investigated for therapeutic purposes although other species have also been implicated for therapeutic uses. The species grow to 20-30 cm tall, with finely divided leaves wherein the leaf segments are narrowly linear to threadlike. The flowers are white, yellow, pink, pale blue or pale purple, with 5-10 petals. The fruit is a capsule composed of several united follicles, each containing numerous seeds while in some species (e.g. *Nigella damascena*), the capsule is large and inflated. The parts of the plant most commonly used for the therapeutic purposes in the "Alternative Medicinal" systems are the seeds which are contained in an inflated capsule formed from the united follicles containing considerable amount of oil having pungent and bitter taste. Commonly the seeds are used primarily as a spice and food preservative [4].

Black cumin (*Nigella sativa* L.) and its oil contain appreciable quantities of carbohydrates, proteins and fats. Moreover, potassium, calcium, phosphorous and magnesium were predominant minerals, considerable quantities of sodium, iron, manganese, zinc and copper were also present. Characterization of fixed oil enumerated that polyunsaturated fatty acids were the dominating fraction i.e., 60.17±1.53 per cent as compared to saturated and monounsaturated fatty acids

i.e., 16.64±0.91 and 22.47±0.59 per cent, respectively. Carotenoids and tocopherols were 450.66±16.21 mg/kg-oil, where as thymoquinone content was observed to be 201.31±13.17 mg/kg of seeds [3].

The oil content of the *Nigella sativa* seeds ranged from 28.0 to 36.4 %.[1] crude oil and thymoquinone extracted from *Nigella sativa* seeds and oil are effective against many diseases like cancer, cardiovascular complications, diabetes, asthma, kidney disease etc. However, some studies showed that thymoquinone has antioxidant role and improves body's defence system. [2]

Cookies have high shelf life product due to their low moisture content. The product is liked by all segments of population and could serve as a good carrier for delivering novel medicinal ingredients. Cookies are generally differentiated from biscuit by their higher fat content. The higher fat content of cookies is sometime responsible for deterioration due to oxidation. It was hypothesized that incorporation of black cumin seeds oil and meal may prevent the oxidation of cookies.

The chemical composition of cookies is of significance importance as they contain 22-30% of fat, 4-8% protein contents and 60-70% carbohydrates. These constituents also impart desirable quality characteristics to final produce. Shortening used in the cookies contributes to texture and flavor of the end product. It also acts as lubricant and provides plasticity to the dough by preventing excessive gluten development. Starch and sucrose can also affect hydration in biscuit dough, consequently improving quality of cookies. [5]

In the view of the importance of black cumin seed oil as a therapeutic, medicinal and nutritional value, the present study has been undertaken to observe the effect of different incorporation levels of black cumin seed oil fractions on physical parameters, chemical composition as well as sensorial quality characteristics of cookies.

II. MATERIALS AND METHODS

A. Selection of Ingredient

Raw material such as flour, sugar, shortening and black cumin seed were procured from local market of Aurangabad.

B. Extraction of Oil

The oil of *N. sativa* seeds was obtained by Soxhlet extraction method A.O.A.C. (1990) [6]. 25 g seeds were crushed and wrapped with a filter paper and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. The oil was extracted for 3h by using petroleum ether as a solvent. After extraction the solvent was removed by hot air oven. The same method was repeated by using acetone as extract agent.

C. Product development

The cookies were prepared by using standard recipe. Black cumin seed fixed oil was replaced by shortening at 3, 6 and 9 % concentration, to avoid the high concentration of fat in final product.

Table-1: Recipe used for development of cookies

Ingredient (g)	Control (O)	Sample (A)	Sample (B)	Sample (C)
Wheat flour	100.0	100.0	100.0	100.0
Sugar	50.0	50.0	50.0	50.0
Fat	50.0	48.5	47.0	45.5
Black cumin seed oil	----	1.5	3.0	4.5
Baking powder	1.5	1.5	1.5	1.5
Ammonium carbonate	0.5	0.5	0.5	0.5

Method of preparation of cookies

The dough was prepared and rolled in a proper shape of thickness 6 mm and cut into round shape with the help of cutter. These cookies were baked at 175°C for 15 min.

D. Sensory Evaluation

Sensory evaluation of fresh samples was done by a panel of semi trained members, based on a 9-point hedonic scale (BIS-1975), wherein 9 denoted extremely desirable and 1 denoted extremely undesirable. Water was provided for oral rinsing between the samples. Obtained data was statistically analyzed to see the significant difference among the characters. Results were compared with control samples without addition of black cumin seed oil.

E. Analytical Procedures

The moisture, carbohydrate, fat, protein and ash contents were examined according to the methods of Association of Official Analytical Chemists.

III. RESULTS AND DISCUSSION

The black cumin seed oil was extracted and the efforts were also made to study the utilization of black cumin seed oil a novel ingredient in formulation of cookies. The results pertaining to different analytical investigations were viewed under scientific relevance and are summarized as follows under suitable headings.

A. Extraction of black cumin seed oil

The efforts were made to study the possible utilization of black cumin oil in incorporation into various value added food products. In search of getting maximum yield of oil, the seeds were extracted by using different solvents in the soxhlets apparatus while other parameters *viz.* amount of black cumin seeds (25 g) and quantity of solvent (150 ml) were kept constant. The results pertaining to yield of black cumin oil are presented in Table-2.

Table-2: % yield of black cumin seed oil extracted by different solvents

Solvent	Weight of black cumin seed	Time of Extraction	Weight of oil	% yield
Petroleum ether	25 g	3hrs	8.25	33.0%
Acetone	25g	3hrs	7.85	31.4%

* Each value represents the average of three determinations

On the basis of observed result the petroleum ether extract yield 33.0% oil and acetone extract yield 31.4%. It could be concluded that black cumin contains significantly higher amount of fat (33.0 %) which defines its oilseed value. Findings of present investigation were in close conformity with values described in literature of Bertrand Matthaus and Mehmet Musa Ozcan (2011).

B. Organoleptic evaluation of black cumin seed oil fortified cookies

Cookies prepared by using different concentration of black cumin seed oil was evaluated for sensory evaluation. Analysis revealed that as concentration of oil increased the organoleptic score get decreased to unacceptability due to its specific taste, value showed in Table-3 hence the 6 % fortification was possible to produced value added cookies and it was taken for further studies. The data pertaining to organoleptic quality evaluation of product is presented in Table-3.

Table-3: Organoleptic evaluation of cookies fortified with black cumin seed oil

Sample Code	Colour	Taste	Texture	Flavour	Appearance	Overall acceptability
Control	8.5	8.4	8.8	7.9	8.3	8.38
A	8.4	8.3	8.9	7.5	8.1	8.22
B	7.9	5.6	8.7	5.4	7.6	7.02
C	4.3	3.4	8.8	3.6	4.1	4.84
Mean	7.2750	6.4250	8.8000	6.1050	7.0275	7.1160
S.E. ±	0.1572	0.1299	0.1392	0.0392	0.0337	0.0271
C.D.at 5%	0.4351	0.3596	0.3853	0.1087	0.0932	0.0751

* Each value represents the average of 10 determinations

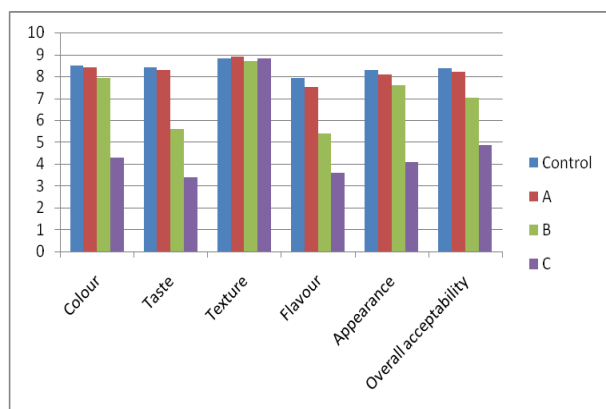


Fig. 1: Organoleptic evaluation of cookies fortified with black cumin seed oil

a) *Effect of black cumin seed oil fortification on colour characteristics of cookies*

Color is considered as one of the important consumer quality judging parameter in selection of food products. Attractive colour of product is a must have in fast moving consumer goods to appeal consumer for consumption.

It could be observed from Table-3 cookies fortified with black cumin seed oil, the sensorial score for colour was found to decrease linearly with increase in level of fortification. Bright and light yellow cookies with increase in level of black cumin seed oil found to get contrast and dull has marked negative effect on colouring parameter of cookies.

b) *Effect of black cumin seed oil fortification on Taste of cookies*

With respect to taste characteristics of black cumin fortified cookies, 8.4 readings were observed for control sample while sample containing 3 % of black cumin seed scored 8.3 %. On consumer point of view, negligible change in taste was observed at level of 3 % incorporation yet the taste was not solely detectable as that of typical black cumin seed oil taste while more change was observed in sample containing 6 % of black cumin seeds,. However, when the level of fortification was further increase to 9 % there was drastic reduction in taste and the sample were not liked by the panel members.

On the basis of observed results, it could be concluded that black cumin seed oil incorporation up to the level of 6 % is acceptable.

c) *Effect of black cumin seed oil fortification on Textural characteristics of cookies*

Textural characteristics of cookies play a pivotal role in judging its consumer acceptability. It could be stated that textural characteristics of cookies are basically function of moisture content. It could be observed from Table-3 that in samples containing black cumin seed oil, the textural properties are not much more affected with increase in levels of black cumin seed oil.

d) *Effect of black cumin seed oil fortification on Flavour profile of cookies*

Flavour being a combination of taste, smell and mouth feel, has large number of factors it. Incorporation of black cumin seed oil resulted in negligible reduction of flavour characteristics up to the level of 3 %, while further increase in levels reduced the flavour scores to unacceptability. This may be due to typical flavour of black cumin, which could be prominently sensed in sample containing 6 and 9 % of black cumin seed oil. With the reference to incorporation levels of black cumin, it could be concluded that sample A and B is acceptable, amongst black cumin seeds incorporated cookies.

e) *Effect of black cumin fortification on Appearance characteristics of cookies*

The appearance properties of black cumin seed oil incorporated cookies were found to decrease with increase in concentration. The cookies were at the mark of unacceptability at higher concentrations. The incorporation of black cumin seed oil resulted in darkening of cookies which were principally responsible for reduction of appearance.

f) *Effect of black cumin fortification on Overall acceptability of cookies*

Overall acceptability of product is depend on various factors including taste, colour, texture and appearance. The data pertaining to overall acceptability of product is described in Table-3. It could be observed from the table that overall acceptability of samples containing 3 % and 6 % of oil was acceptable.

It could be concluded on the basis of results that black cumin seed oil incorporation up to the level of 6 % acceptable on the basis of the overall acceptability score of cookies. While 9 % black cumin seed oil fortified cookies was unacceptable.

C. *Physical parameters of black cumin seed oil fortified cookies*

Physical properties of cookies are indicative of the quality characteristics. The data pertaining physical parameters of black cumin seed oil fortified cookies is presented in Table-4. It could be observed from the table that weight of cookies remained more or less similar (though slightly lower) to that of control sample. Maintaining the constant weight of final product is essential to comply with the regulations and delivering uniform product to consumer.

Table-4: Physical parameters of black cumin fortified cookies

Sample Code	Weight (g)	Diameter (cm)	Thickness (cm)	Spread factor	Top grain development
Control	20.0	5.3	0.86	7.07	Moderate
A	19.8	5.1	0.84	6.98	Most
B	20.0	5.2	0.88	7.05	Most
C	19.6	5.2	0.86	6.94	Most

* Each value is average of minimum three determinations

Results related to physical traits like diameter, thickness and spread factor indicated significant variations among treatments as a function of varying level of black cumin constituents. Addition of black cumin seeds oil reported lowest value of diameter for A sample while B and C are found to possess same diameter as compare to control sample.

The data pertaining to thickness indicated gradual increase with increase in black cumin seed oil incorporation. While in case of sample containing 6 % black cumin seed oil maximum thickness was observed.

The slight lower spread factor was observed more or less similar in case of all sample incorporated with black cumin seed oil cookies. On the basis of obtained results, it is difficult to establish any relationship between the spread factors with different level of black cumin seed oil. However, it could be concluded that spread factor is not much affected by the incorporation of black cumin seed oil. With regard to top grain development of cookies, most of samples were found to be superior to that of control sample. It may be concluded that incorporation of black cumin seed oil enhanced the top grain of cookies. Replacement of normal shortenings with edible oils increased the diameter of cookies, while decreasing the thickness of cookies thus resulting in higher spread (Bandarra et al., 2007) that strengthened the results of present exploration.

D. Proximate composition of black cumin seed oil fortified cookies

On the basis of organoleptic evaluation results, 6% fortification of black cumin seed oil was possible to produce cookies with acceptance. So B sample was selected for further studies and the data pertaining to proximate properties of these cookies are summarized in Table-5.

Table-5: Proximate composition of black cumin fortified cookies

Parameters	Control	Sample B
Moisture (%)	3.17	3.03
Carbohydrate (%)	68.32	67.37
Proteins (%)	4.98	5.32
Fat (%)	20.17	21.12
Ash (%)	0.35	0.20

* Each value is average of minimum three determinations

It could be observed from Table-5 that moisture, carbohydrate and protein content of cookies were more or less similar with control sample i.e. 3.03%, 67.37 % and 5.32 percent respectively, however it could be observed from the table that crude fat content of black cumin seed oil incorporated cookies was found to be higher (21.12 %) and ash content was found to be lower (0.20%).

IV. CONCLUSIONS

The oil extracted by petroleum ether as solvent yield more oil as compare to acetone as solvent. The present study aimed to develop value added cookies by incorporation of *Nigella Sativa L.* oil as a nutraceutical. The findings revealed that product 6% of *Nigella Sativa L.* oil fortification was possible to produce value added cookies.

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