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Utilization of Black cumin seed (*Nigella sativa* L.) fractions on quality characteristics of cookies

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Abstract

Black cumin (*Nigella sativa* L.) locally known as “*Kalonji*” is a good source of nutritionally essential components. Black cumin seeds have been used as herbal medicine by various cultures and civilizations to treat and prevent a number of diseases. Black cumin seed fixed oil contains appreciable quantities of unsaturated fatty acids, especially polyunsaturated fatty acids. In present investigation, the efforts were made to study the effect of incorporation of different levels of black cumin seeds fraction in preparation of cookies so as to enhance its nutritional, organoleptical and nutraceutical properties. The results revealed that black cumin fixed oil incorporation in cookies enhances the sensorial as well as physico-chemical properties of cookies up to standard level. The results are more promising in the samples containing black cumin fixed oil. The crude fibre and protein content of prepared cookies were present in high amount as well as total tocopherol content was in sufficient quantity.

Keywords: Black cumin, fixed oil, cookies, sensorial quality, total tocopherol

Introduction

Black cumin seed (*Nigella sativa* L.) is famous for the saying of the Prophet Muhammad (*Sal Lal Lahu Alayhi Wa Sallam*) "Hold on to use of the black cumin seed, for it has a remedy for every illness except death" (Bukhari, 1985) [3]. The seed of *Nigella sativa* is known by many different names like black seeds or black cumin. In old Latin, it is called as ‘*Panacea*’ meaning ‘cure all’ while in Arabic it is termed as ‘*Habbah Sawda*’ or ‘*Habbat el Baraka*’ translated as ‘*seeds of blessing*’. In China it is referred as *Hak Jung Chou* while in India it is called as *Kalonji* and ‘*Kalvanji*’ in Urdu and in Persian, it is called as *Shoneez*. It is well known in the Middle East, Middle Asia and Far East as a natural remedy for many ailments.

Black cumin seed fixed oil contains appreciable quantities of unsaturated fatty acids, especially polyunsaturated fatty acids; constitute the bulk of oil ranging from 48-70%, while monounsaturated (18-29%) and saturated fatty acids (12-25%) are in the lesser proportions. Additionally, the presence of dihomolionolenic acid (1.9-2.3%) is accredited for its antioxidant and lipid lowering potential (Nickavar *et al.*, 2003; Cheikh-Rouhou *et al.*, 2007) [10, 4]. The study was conducted to analyse the physicochemical properties of Black cumin seed and its fixed oil.

It has been realized that diet-based therapies are among the most effective and sustainable ways to overcome various maladies. However, development of successful food-based strategy requires knowledge of nutrients dense sources, target communities and indeed selection of suitable vehicle (Fiedler *et al.*, 2008) [5]. Functional foods are important components in such interventions aiming to provide health benefits beyond their basic nutrition (Gidding *et al.*, 2005) [6]. Wheat based baked products are considered suitable vehicles for incorporation of functional ingredients that can easily be accessible to masses especially in countries like India where wheat is staple diet (Jacob and Leelavathi, 2007) [8]. In the view of the importance of Black Cumin Seed and its fixed oil as a therapeutic, medicinal and nutritional value, the present investigation has been undertaken to utilize various fractions of black cumin seed in cookies and evaluate its quality characteristics.

Materials and Methods

Pure and healthy Black cumin seeds were procured from local market. The Cookies were prepared by using standard recipe (Table 1).

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Black cumin seed and defatted meal was replaced by wheat flour at different concentrations. Whereas fixed oil was replaced by shortening at different concentrations (2, 4, 6 and 8 per cent) to avoid the high concentration of fat in final product. The organoleptic evaluations of prepared cookies

were done by Nine point headonic scale. The proximate composition of cookies were analysed by standard methods of AOAC (1990) [2]. The total tocopherol content was quantified by Ranganna (1986) [11].

Table 1: Standard Recipe for cookies

Ingredient	Quantity (g)
Wheat flour	100.0
Sugar	65.0
Fat	55.0
Baking powder	1.5
Ammonium carbonate	0.5

Preparation of cookies

Blends were prepared by mixing black cumin seed powder, defatted meal, refined wheat flour in different ratios (2 to 8 per cent) on a dry-to-dry weight basis. These blends were

chosen for acceptable product's physical characteristics as well as better nutritive value in the final product.

The method of preparation of cookies is summarized in flow sheet as follows.

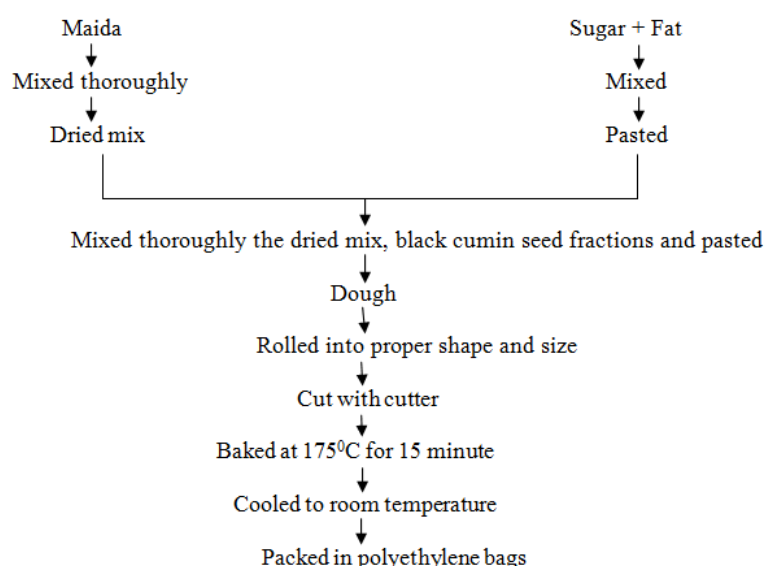


Fig. 1: Flow sheet for preparation of black cumin seed cookies

Results

Organoleptic evaluation of black cumin fortified cookies

Organoleptic characteristics of cookies are pivotal in judging the suitability of product as consumer point of view. The black cumin fortification level in cookies, organized trials were taken by incorporating different levels *viz.* 2, 4, 6, and 8 per cent each of black cumin seeds, fixed oil and defatted meal. The data pertaining to organoleptic quality

evaluation of product is presented in Table-2. The sample codes S₂, S₄, S₆ and S₈ contains 2, 4, 6 and 8 per cents of whole black cumin seed powder while sample codes O₂, O₄, O₆ and O₈ contains 2, 4, 6 and 8 per cents of fixed oil of black cumin seed and the sample codes M₂, M₄, M₆ and M₈ contains 2, 4, 6 and 8 per cents of defatted meal of black cumin seed.

Table 2: Organoleptic evaluation of cookies fortified with black cumin seeds, fixed oil and defatted meal

Sample Code	Colour	Taste	Texture	Flavour	Appearance	Overall acceptability
Control	8.20	8.48	8.31	8.45	8.52	8.50
S ₂	6.25	8.45	8.30	8.40	6.87	8.21
S ₄	4.47	8.21	8.21	8.38	5.27	8.19
S ₆	3.39	4.20	7.23	2.78	3.98	3.19
S ₈	1.96	2.81	4.98	1.76	2.12	2.05
O ₂	8.23	8.49	8.30	8.42	8.52	8.48
O ₄	8.32	8.51	8.45	8.49	8.54	8.53
O ₆	8.45	8.57	8.56	8.52	8.55	8.56
O ₈	8.53	7.86	7.91	8.08	8.55	8.49
M ₂	8.03	8.30	8.29	8.34	8.30	8.23
M ₄	8.00	8.21	7.69	8.56	7.87	7.98
M ₆	6.82	7.98	5.98	6.91	4.50	6.50
M ₈	4.33	5.23	5.01	4.5	4.39	4.50
Mean	6.5369	7.3308	7.4785	7.0456	6.6141	7.031

S.E. +	0.278	0.276	0.278	0.227	0.278	0.278
C.D. at 5%	0.809	0.804	0.808	0.659	0.808	0.808

*Each value represents the average of 10 determinations

Effect of black cumin fortification on colour characteristics of cookies

It could be observed from Table-2 that in case of cookies fortified with black cumin whole seeds, the sensorial score for colour was found to decrease linearly with increase in level of fortification. At the level where concentration of black cumin seeds reached to 6 per cent and above, the color became nearly unacceptable by the consumer. In case of cookies fortified with black cumin fixed oil, it was observed that increase in level of fixed oil resulted in direct increase in colouring characteristics. Color of all the samples was found to superior to that of control sample which signifies beneficial effect of fixed oil incorporation in cookies.

Effect of black cumin fortification on Taste characteristics of cookies

With respect to taste characteristics of black cumin fortified cookies, 8.48 readings were observed for control sample while sample containing 2 per cent of black cumin seed scored 8.45 per cent. On consumer point of view, negligible change in taste was observed at level of 2 per cent incorporation while slightly more change was observed in sample containing 4 per cent of black cumin seeds, yet the taste was not solely detectable as that of typical black cumin seed taste. However, when the level of fortified was further increase to 6 and 8 per cent there was drastic reduction in quality. In case of samples containing black cumin oil, it was observed that there was significant increase in taste quality up to the level of 6 per cent incorporation while further increase in concentration resulted in reduction in taste scores. Nearly same phenomenon as that of black cumin seed in corporation, was observed in defatted meal incorporation, in terms of taste.

Effect of black cumin fortification on Textural characteristics of cookies

Textural characteristics of cookies play a pivotal role in judging its consumer acceptability. It could be observed from table-2 that in samples containing black cumin whole seeds, the textural properties are gradually decreasing with increase in levels up to cookies containing 4 per cent of black cumin seed powder. However, if the level is further increase, the textural qualities are reaching the scores of unacceptability. Hence, in black cumin seed fortified cookies, up to 4 per cent level could be considered acceptable. In case of samples containing black cumin fixed oil, it could be observed that increase in concentration of black cumin oil resulted in enhancement of textural quality characteristics up to the level of 6 per cent, while further increase in black cumin oil seed level results in lower sensorial scores for texture. An inverse relation is observed in case of sample containing defatted black cumin fixed oil, sample containing 2 per cent of black cumin defatted meal is observed to be superior amongst treated sample while the reading for textural score were still lesser than that of control sample.

Effect of black cumin fortification of 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 resulted in negligible reduction of flavour characteristics up to the level of 4 per cent, while further increase in levels reduced the flavour scores to unacceptability. Cookies incorporated with black cumin fixed oil are observed to enhance the flavour characteristics up to the level of 6 per cent, while 8 per cent levels were observed to have lower flavour profile. Surprising results have been observed in case of sample containing defatted black cumin meal. Defatted black cumin meal incorporation showed to improve the flavour up to level of 4 per cent while further increase in level of incorporation resulted in lowering the scores.

Effect of black cumin fortification of Appearance characteristics of cookies

The appearance properties of black cumin seed incorporated cookies were found to decrease with increase in concentration. The cookies were at the mark of unacceptability at higher concentrations. The incorporation of whole black cumin seeds resulted in blackening of cookies which were principally responsible for reduction of appearance. In case of sample containing fixed oil, appearance properties were enhanced with the levels of fixed oil incorporation. In case of samples containing defatted black cumin meal, appearance characteristics were also found to decrease while the reported scores were superior to that of cookies containing whole seed samples.

Effect of black cumin fortification of overall acceptability characteristics 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-2. It could be observed from the table that overall acceptability of samples containing 4 per cent, 6 per cent of fixed oil and 2 per cent defatted black cumin meal was superior to that of control sample.

Effect of treatment on physical attributes of cookies fortified with whole seed powder of Black cumin

Physical properties of cookies are indicative of the quality characteristics. The data pertaining physical parameters of black cumin fortified cookies is presented in table-3. It could be observed from the table that weight of cookies remained more or less similar (though slightly lower) to that of control sample. Addition of black cumin seeds reported lowest value of diameter for S₄ sample while S₂, S₆ and S₈ are found to posses same diameter. More or less similar results were observed in sample containing fixed oil and defatted black cumin meal incorporated cookies. The data pertaining to thickness indicated gradual increase with increase in black cumin seed incorporation. While in case of sample containing black cumin oil, maximum thickness was observed in sample containing 4 per cent of oil. Random results were observed in case of defatted black cumin meal incorporated cookies. Maximum spread factor was observed in case of sample containing 6 per cent of defatted meal, followed by 6 per cent defatted meal and 4 per cent fixed oil incorporated cookies. With regard to top grain development

of cookies, most of samples were found to be superior to that of control sample.

Proximate Composition of Black Cumin Fortified Cookies

From obtained results pertaining to organoleptic evaluation and physical parameters, it was found that certain constituent incorporation level were superior to others. On the basis of these results it could be observed that sample containing 4 per cent black cumin seeds, 6 per cent black cumin fixed oil and 2 per cent defatted black cumin meal given best amongst there category for organoleptic and physical characteristics. On the basis of obtained results these samples were selected for further studies and the data pertaining to proximate properties of these cookies are summarized in Table-4. It could be observed from Table-4 that moisture content of all cookies were more or less

similar. The sample containing 4 per cent of black cumin seeds was found to be highest (3.17 per cent) where lowest readings were observed for fixed oil incorporated cookies (3.03 per cent). Carbohydrate content of control sample was found to be highest where lowest was for fixed oil incorporated cookies. Incorporation of black cumin constituents significantly increased the protein content of sample while maximum score was observed for 4 per cent black cumin seeds. Fixed oil cookies were prepared by replacing the level of shortening with black cumin fixed oil, however it could be observed from the table that crude fat content of black cumin fixed oil incorporated cookies was found to be higher (26.21 per cent). Crude fat content of black cumin fixed oil incorporated cookies was higher to other sample. Black cumin seed and defatted meal incorporation also significantly increase the crude fibre and ash content of cookies.

Table 3: Physical parameters of black cumin fortified cookies

Sample Code	Weight (g)	Diameter (cm)	Thickness (cm)	Spread factor	Top grain development
Control	20.0	6.0	0.86	7.07	Moderate
S ₂	19.6	5.8	0.82	6.97	Most
S ₄	19.8	5.7	0.84	6.94	Most
S ₆	19.7	5.8	0.85	6.96	Most
S ₈	19.8	5.8	0.86	6.96	Moderate
O ₂	19.8	5.8	0.84	6.98	Most
O ₄	20.0	5.9	0.88	7.05	Most
O ₆	19.6	5.7	0.86	6.94	Most
O ₈	19.6	5.8	0.86	6.96	Moderate
M ₂	19.8	5.8	0.87	7.05	Most
M ₄	19.6	5.9	0.85	6.98	Most
M ₆	19.9	5.9	0.89	7.07	Most
M ₈	19.7	5.8	0.85	6.98	Moderate
Mean	1.9757	5.8231	0.8561	6.9931	
S.E. \pm	0.278	0.168	0.0292	0.228	
C.D.at 5%	0.807	0.489	0.0848	0.662	

* Each value is average of minimum three determinations

Table 4: Proximate composition of black cumin fortified cookies

Sample Code	Moisture (%)	Carbo-hydrate (%)	Proteins (%)	Fat (%)	Crude fibre (%)	Ash (%)
Control	3.17	68.32	4.98	20.17	0.39	0.35
S ₄	3.21	65.97	7.232	22.12	0.72	0.71
O ₆	3.03	63.37	6.325	26.21	0.41	0.51
M ₂	3.19	66.33	6.833	19.97	0.90	0.58
Mean	3.15	65.99	6.34	22.11	0.60	0.53
S.E. \pm	0.0321	0.817	0.104	0.409	0.042	0.042
C.D.at 5%	0.146	2.66	0.339	1.33	0.137	0.137

* Each value is average of minimum three determinations

Table 5: Total to copherol content of Black Cumin Fortified Cookies

Sample codes	Total Tocopherol contents		
	Initial Black cumin seed constituents (mg)	Cookies (mg)	Retention (%)
S ₄	14.39	12.87	89.43
O ₆	21.57	19.73	91.46
M ₂	0.08	0.07	87.5
Mean	12.01	10.89	89.46
S.E. \pm	0.645	0.408	0.0422
C.D. at 5%	2.10	1.32	0.137

* Each value represents the average of three determination

Changes in total tocopherol content of Black Cumin Fortified Cookies

The total to copherol content of black cumin seed is 359.82 mg/100g. Table 13 shows changes in total to copherol content and its retention in final product. It can be depicted

from table 13 that initial to copherol content of black cumin seed, fixed oil and defatted meal was 14.39 mg, 21.57 mg and 0.08 mg respectively. The cookies fortified with black cumin seed contains the 12.87 mg of to copherol while fixed oil fortified cookies has 19.73 mg of to copherol. The

defatted meal contains less amount of fat and hence the tocoherol content of defatted meal fortified cookies was 0.07 mg. Results in terms of per cent retention of to copherol showed that the highest value of 91.46 per cent

was found in case of cookies fortified with fixed oil followed by 89.43 per cent of retention in cookies fortified with black cumin seed. Defatted meal fortified cookies has retention of 87.5 per cent.

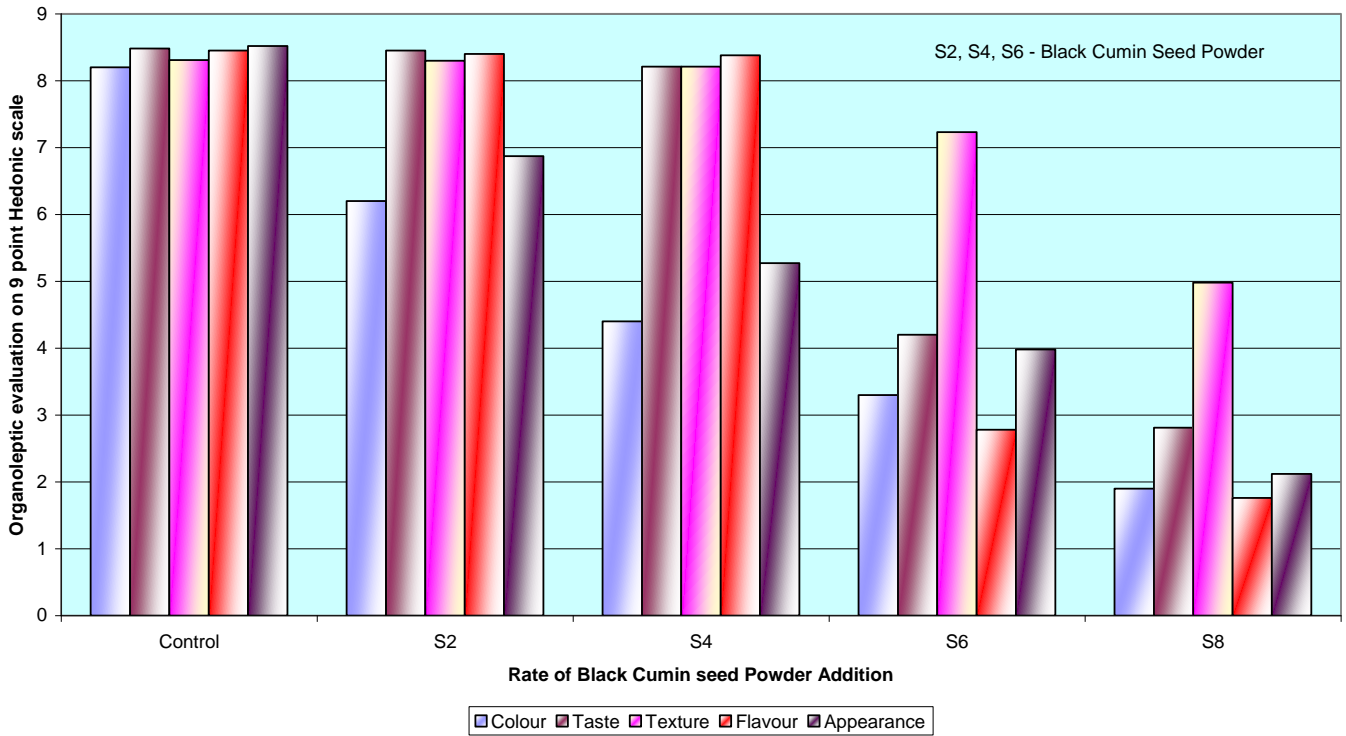


Fig 2: Organoleptic Evaluation of Black Cumin Seed Powder Fortified Cookies

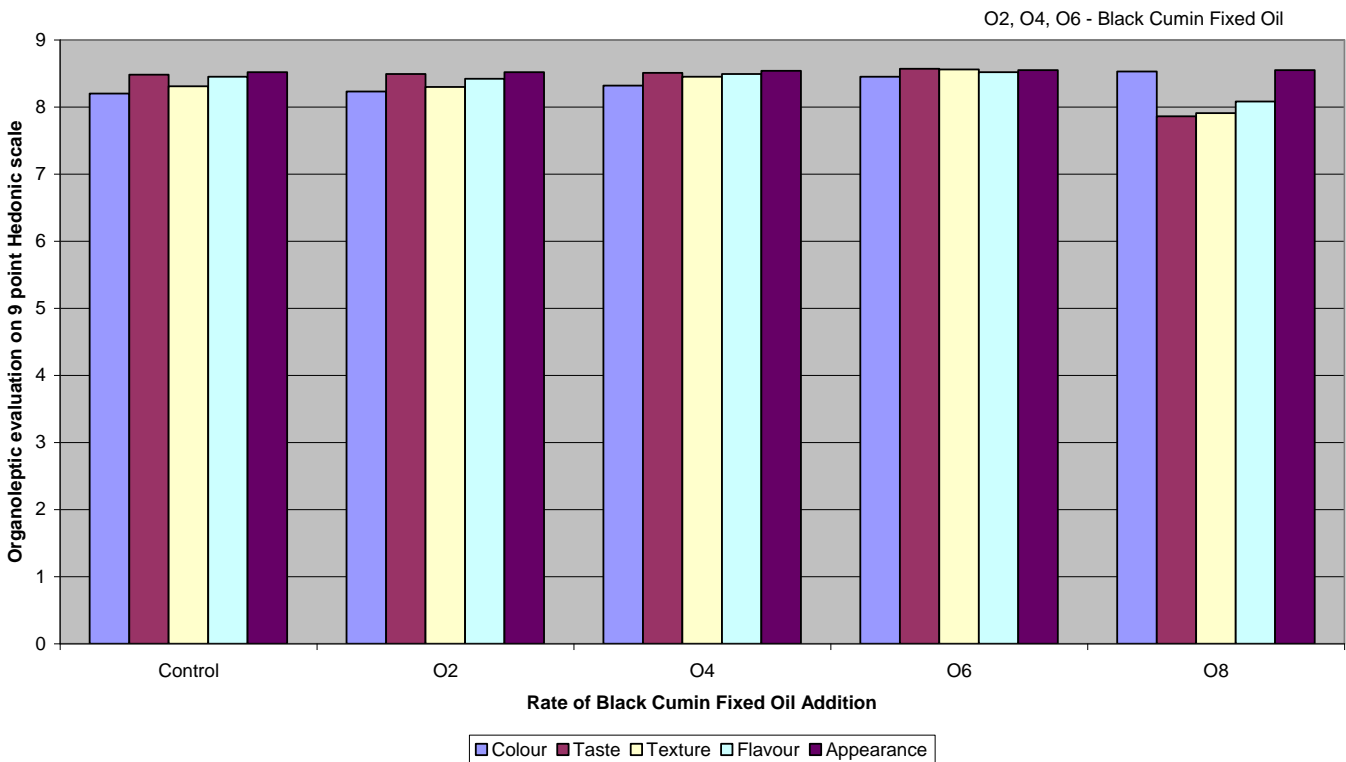


Fig 3: Organoleptic Evaluation of Black Cumin Fixed Oil Fortified Cookies

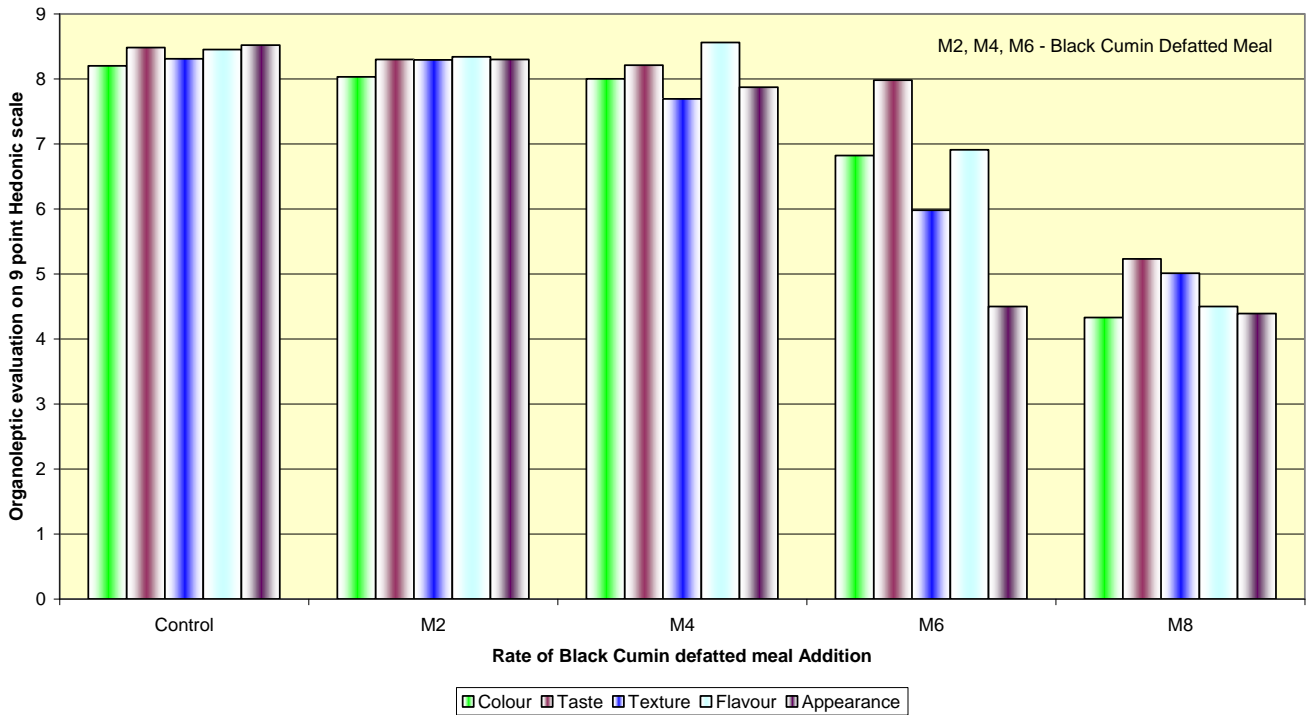


Fig 3: Organoleptic Evaluation of Black Cumin Defatted meal Fortified Cookies

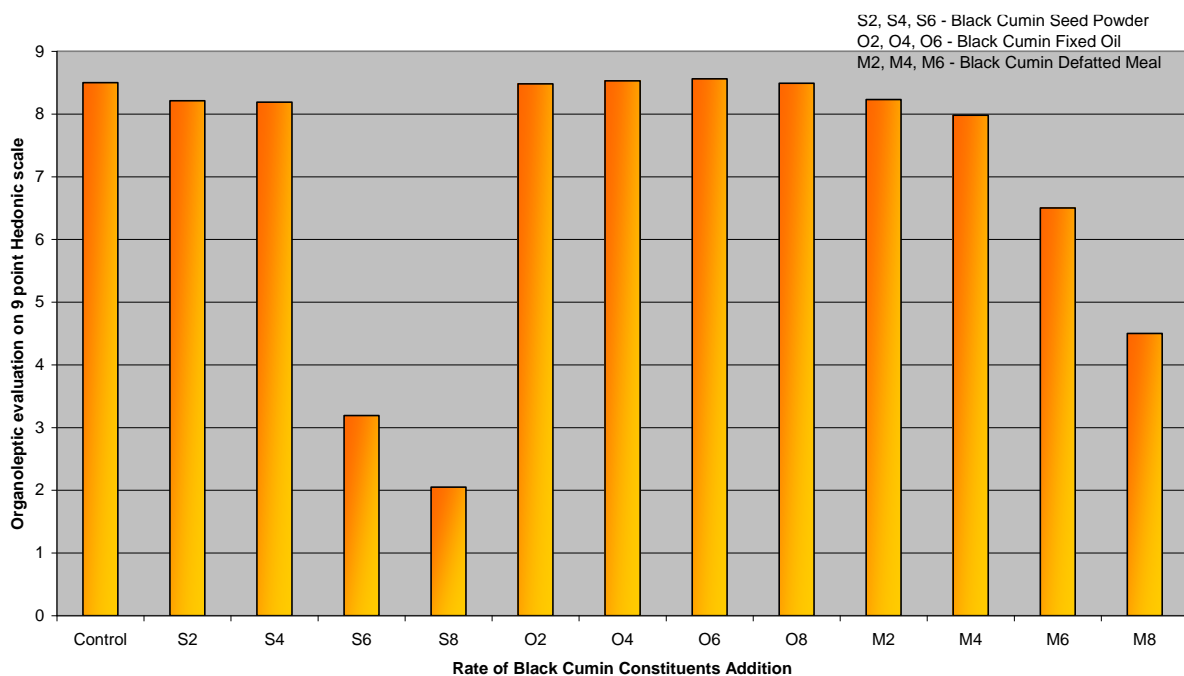


Fig 3: Overall Acceptability

Conclusion

A good quality cookies can be prepared with the fortification of black cumin seed 4 per cent, fixed oil 6 per cent and defatted meal of 2 per cent. The prepared cookies are found to be organoleptically acceptable and rich in nutritional profile and also possess health benefits. The prepared cookies were rich in crude fibre and protein content. The total toopherol content was higher in fixed oil containing cookies. Hence functional food can be made using black cumin seed and its fractions.

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