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Research Article

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Morphological Characteristics of Black Cumin (*Nigella sativa*) Seeds

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Abstract Morphological characteristics of two types of Black cumin seeds (*Nigella* sativa), Indian and Ethiopian origin were subjected to examine in this study. Therein, two physical characteristics namely colour and appearance were investigated with a view of determining the possibility of the seed for decorticating. The whole seed, seed coat and cotyledon of Ethiopian origin *Nigella* seeds were examined using a Scanning Electron Microscope. Present study was also performed to determine the colour of both types of seeds "Indian and Ethiopian" before and after decortications. Results revealed that black cumin seeds could have the possibility of decortications as morphological features of the seeds can facilitate to create an abrasion and friction actions. Colour of the seed was remarkably improved after decortication, because L^* values before and after decortications were 8.25 and 18.68 respect to Indian origin where as 6.87 and 15.77 in Ethiopian origin respectively.

Keywords *Nigella sativa*, morphological characteristics, colour, L value

1. Introduction

The black cumin (*Nigella sativa*) which belongs to the family Ranunculacea. The plant has a slight hairy stem and shiny green, tripartite leaves [1] and very attractive flowers at the end of the stem. The flowers are milky white in colour with a slight blue or green tint at the tip. Seeds are contained in seedpods which are black in colour and slightly curved with three edges. Nigella sativa plants mature in one year and are between one and two feet tall [2]. A whole black cumin seed can be characterized by a very dark colour and a thin, crescent shape with a pungent bitter taste and smell. Nigella seeds have been employed for thousands of years in medicine as a spice [3]. The principal component in the volatile oil of black cumin is p-cymene. It has been traditionally used for the treatment of asthma, cough, bronchitis, headache, rheumatism, fever, influenza and eczema [4]. Most predominant advantage of black cumin seed is extracting of oil using different means such as solvent extraction and cold pressing. There is an increasing interest in using this nutritive oil in many fields and cold pressing procedure has become the consumer-friendly method due to their interest in natural food products [5]. But today industries are encountered with barriers of cold pressing because black colour pigment in seed coat is coming into oil and it takes considerable time to sediment. Therefore, it is very important to explore the possibilities to decorticate the seed prior to oil extraction; because oil in light color has a strong demand in the commercial market.

2. Materials and Method

2.1 Observing through Scanning Electron Microscope

The three parts of the Ethiopian black cumin, the seed coat, cotyledon and the whole seed were observed under the Scanning Electron Microscope (SEM), model EVO/LSIS and ZEISS brand utilizing the Smart SEM software at Geological Department of University of Peradeniya, Sri Lanka.

2.2 Colour analysis

Colour of Ethiopian and Indian origins of black cumin samples were determined using a Lovibond R LC Chroma-Meter based on the L* (lightness or brightness), a* (redness/greenness), b* (yellowness/blueness) values, Chroma (C) and hue angle (H_0) according to the procedure described by Bai et al., (2013). Hue was used as an attribute to determine the color. The reflectance Chroma-Meter was standardized using a white plate; reflectance values of Y= 93.93, x=0.3131, y=0.3189 were used as standards. Black seeds of Indian origin were placed in a clean Petri dish with 3 cm depth, the measuring head was carried near the surface of the samples and the values for L*, a*, b* were recorded. Simultaneously, Ethiopian origin was tested for L*, a*, b* values. In order to increase the effectiveness of the results obtained, 10 consecutive measurements were taken from each type at 3 different positions. The equation, [$H_0 = \tan^{-1}$ (b*/a*)] was used to calculate the Hue angle (H_0)

3. Results and discussion

3.1 Morphological features of black cumin seed

Ethiopian origin of black cumin was observed under scanning electron microscope using whole seed, cotyledon and seed coat separately. Each part of the seed under different magnification was observed and features of them are given in figures 1,2,3,4,5 and 6.

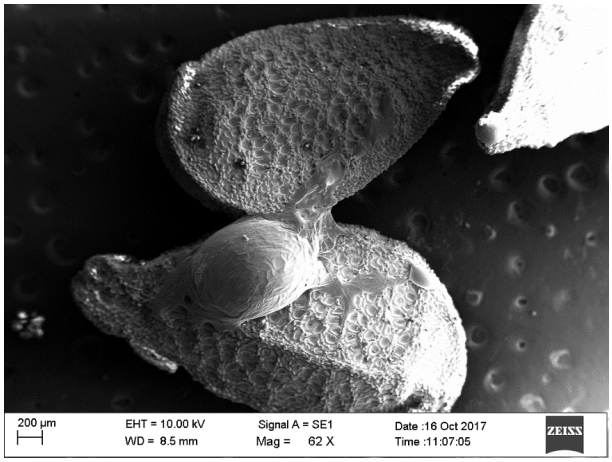

Figure 1: Scanning Electron Microscopic image of Nigella whole seed: magnification 62×

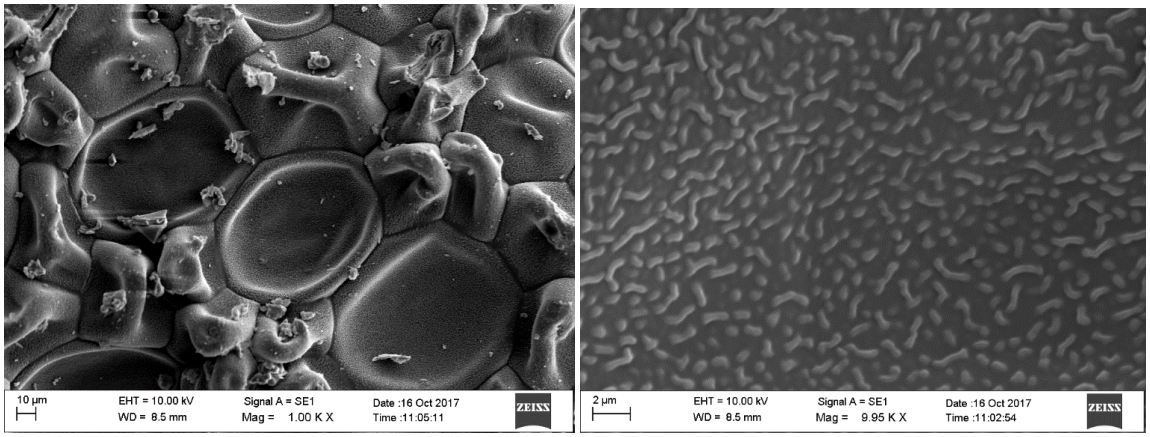

Figure 2: Scanning Electron Microscopic image of Nigella sativa: magnification1000× and magnification 9.95K respectively

As shown in the figures 1, 2 & 3, a rough surface can be seen in the whole seed of the black cumin and the triangular shape of the seed as most studies have stated. Being surface rough is very ideal for the decortication process of Nigella seeds. As observed, cells have compact together in a way which is clearly observable in figure 2 and further

magnification of one cell is depicting at the right side which clearly indicates rough and divert nature of the seed coat.

A very clear image of the surface structure of black cumin seed after removing the seed coat/hull is observed through Scanning Electron microscope and the image is given in figure 3.

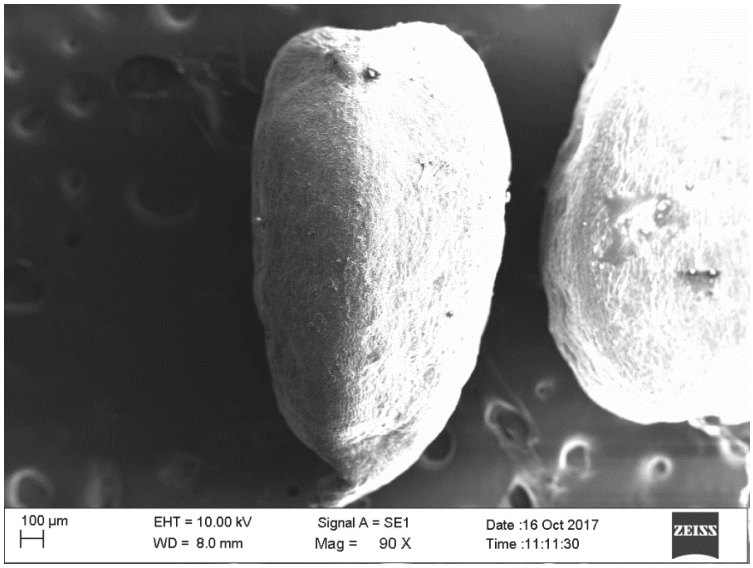

Figure 3: Scanning Electron Microscopic image of the Nigella seed after removing the seed coat; magnification 90×

A smooth surface could be observed clearly after decortication or dehulling the Nigella seed coat. At high magnification it is obiously clear that cell structure is totally different from the structure of wole seed as shown in figure 2 and 4

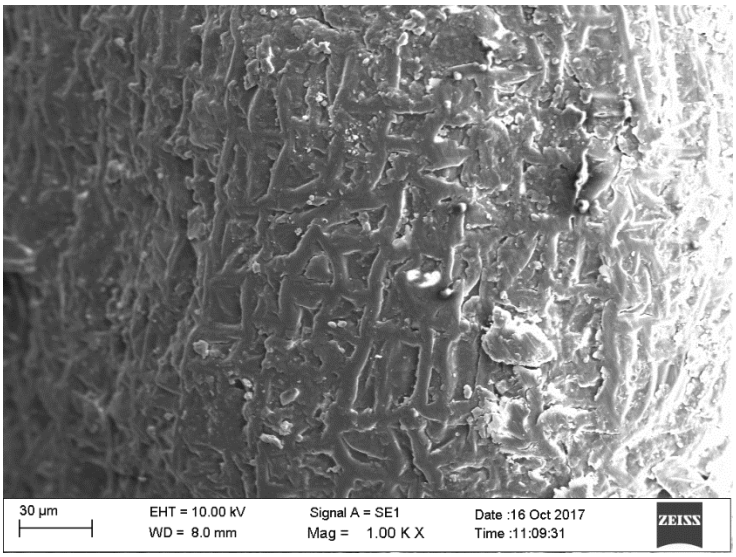

Figure 4: Scanning Electron Microscopic image of Nigella seed after removing the seed coat; magnification 1000×

Decorticated hull itself was observed through Scanning Electron Microscope and morphological features are shown in figures 5 and 6

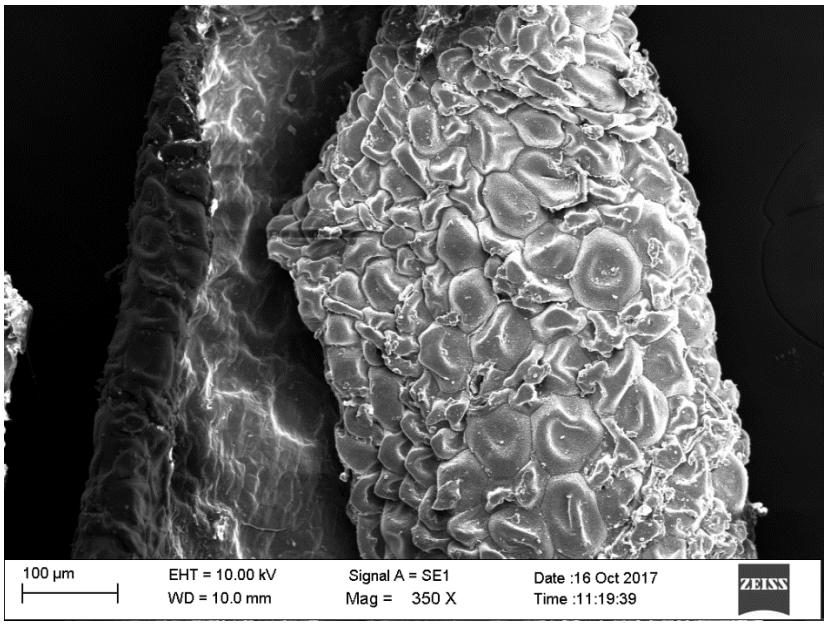

Figure 5: Scanning Electron microscopic image of seed coat of Nigella sativa; Magnification 350×

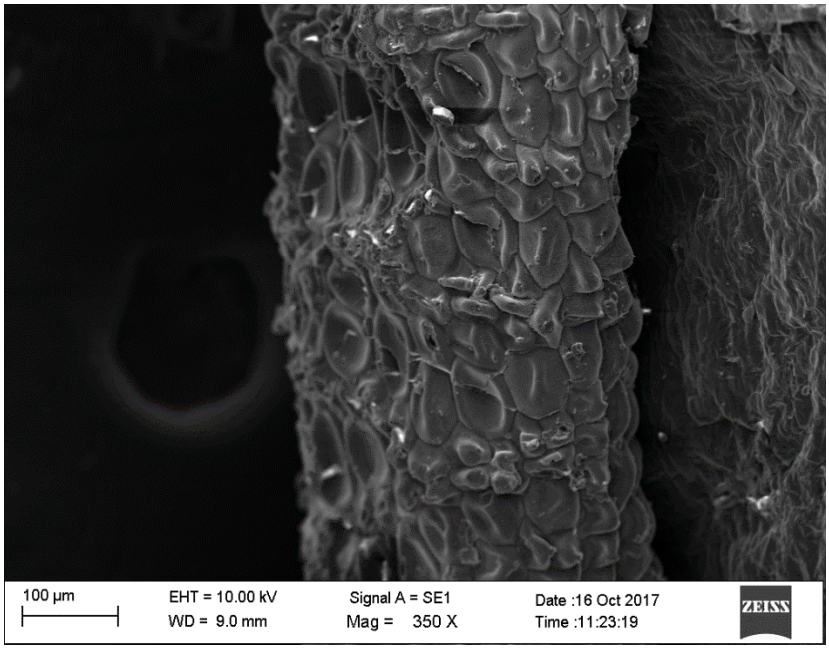

Figure 6: Scanning Electron Microscopic image of seed coat of Nigella sativa; Magnification 350×

Considerable compact cell structure is observed in the seed coat and inner side of the seed coat is also different from outside as shown in figures 5 and 6 and it seems to be removable from the whole seed itself. The surface difference in the seed coat and the cotyledon itself may implies that there is a convenient potential for decortications of the seed.

3.2 Colour value of black cumin seed

L* a* and b* parameters of the Ethiopian and Indian origins Black cumin seeds were recorded by using chromometer and the same colour parameters after decortications process were also measured in order to investigate the colour difference due to dehulling of black cumin seed. L* a* b* C and Hue angle values of the two origins of seeds just prior to and after the decortications are given in the table 1.

Table 1: Colour parameters of Indian and Ethiopian origin Black cumin seeds

Black cumin (Nigella sativa)	L*	a*	b*	C(Chroma)	Hue angle (H^0)
Indian origin	8.25 ± 0.54^a	1.77 ± 0.67	2.11 ± 0.98	2.47 ± 1.02	63.37 ± 11.45
After decortication	18.68 ± 0.86^b	3.13 ± 0.66	5.41 ± 0.96	6.29 ± 0.88	60.66 ± 6.43
Ethiopian origin	6.87 ± 0.80^c	0.40± 0.23	0.89± 0.65	0.77± 0.43	56.37 ± 9.06
After decortication	15.77 ± 1.73^d	3.09 ± 0.59	4.95 ± 0.71	5.75 ± 0.87	58.96 ± 5.44

Data presented as mean values ± S.D (n=10). a, b, c, d letters in same column are significantly different at ($p < 0.05$) level.

L*, a* and b* values of Indian and Ethiopian origin Black cumin seed are given in the table 1. w L*, a*, b* are measurements of brightness, redness and yellowness respectively. As two varieties are almost black in colour, it is impossible to differentiate the two varieties visibly. However, according to the observed values that show there is a slight difference between Indian and Ethiopian varieties. At the same time after decortications of these two varieties, at 95% confidence level there is a significant difference in L* value. Since all Nigella sativa seeds are black in colour and after decortication their colour was close to brown. Hence, lightness is the best parameter to compare these Black cumin seeds before and after decortications.

The Indian origin strain showed a higher L* value which means that Indian origin is lighter than Ethiopian origin. But after decortication, a significant difference of colour can be observed even by naked eye. According to the statistical analysis, colour difference before and after decortication is significantly difference at 95% confidence level ($p<0.05$). Hence it is a new avenue to utilize the meal of decorticated seed cake for new product development as colour of the cake is attractive rather than repulsive.

With regards to the colour parameters of black cumin seeds; the highest L* value was recorded as18.68 in which lightness is very high after decortication of Indian origin. Even the Ethiopian origin shows high L* value (15.77) after decortication. High level of L* value indicates high brightness level and low color intensity as stated in Ratnasooriya, 2010 [6]. Therefore, it is evidence that colour difference can be observed after decortication where intensity of black colour reduces with the removal of seed coat is remarkable and it is clearly illustrated in the figure 7

Hue angle is computed using a* and b* values. Hue angle between 20.14^0 and 90^0 indicates the variation from red color to yellow color as mentioned in Fairchild, 2013 [7]. Low hue angle values indicate tendency towards red color and high hue angle values indicate tendency towards yellow color. But as two varieties are almost black in colour, significant difference in Hue angle was not confirmed by regression model.

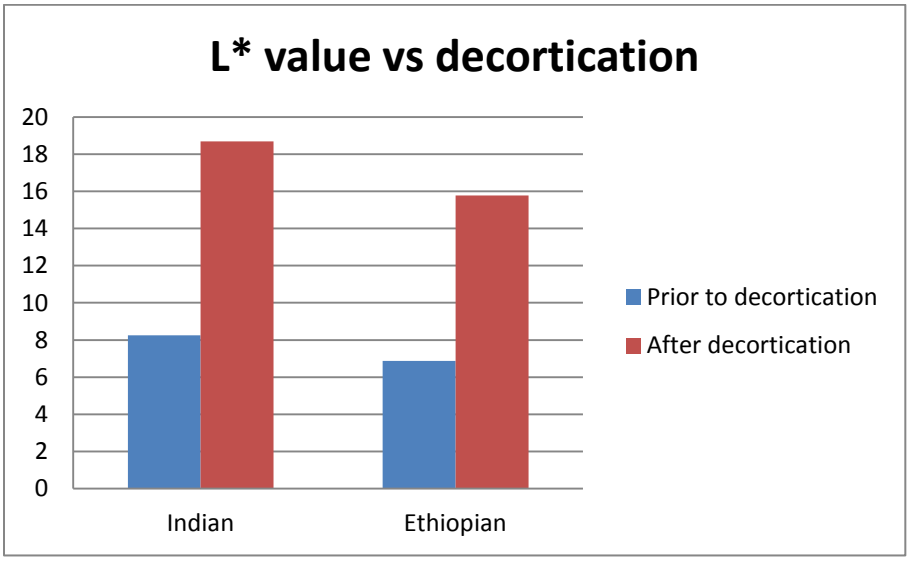

Figure 7: Graphical illustration of differentiation of L^* value with decortication

4. Conclusion

The findings of this study provide clear evidence that there is a significant difference in colour of the seeds before and after decortications. Morphological features of the seed coat as well as seed indicate that the structure of the seed coat facilitates to remove it mechanically. Further appearance of the meal of decorticated seeds will provide a new business venture as it is attractive comparatively the meal with the seed coat.

References

1. Nergiz, C., & Ötles, S. (1993). Chemical composition of Nigella sativa L. seeds. *Food Chemistry*, *48*(July 1992), 259–261.
2. Nadaf, N. H., Gawade, S. S., Muniv, A. S., Waghmare, S. R., Jadhav, D. B., & Sonawane, K. D. (2015). Exploring anti-yeast activity of Nigella sativa seed extracts. *Industrial Crops and Products*, *77*, 624–630.
3. Benkaci-Ali, F., Akloul, R., Boukenouche, A., & Pauw, E. De. (2013). Chemical Composition of the Essential Oil of *Nigella sativa* Seeds Extracted by Microwave Steam Distillation. *Journal of Essential Oil Bearing Plants*, *16*(6), 781–794.
4. Burits, M., & Bucar, F. (2000). Antioxidant activity of Nigella sativa essential oil. *Phytotherapy Research*, *14*(5), 323–328.
5. Kiralan, M., Özkan, G., Bayrak, A., & Ramadan, M. F. (2014). Physicochemical properties and stability of black cumin (Nigella sativa) seed oil as affected by different extraction methods. *Industrial Crops and Products*, *57*, 52–58.
6. Ratnasooriya, C. C., Rupasinghe, H. P. V. & Pitts, N. L. (2012). Physicochemical and Sensory Evaluation of Non-alcoholic Wine-like Beverages Prepared from Selected Grape Cultivars. Journal of Nutrition & Food Sciences, 2, 119-124.
7. Fairchild, M. D. (2013). Color Appearance Models. Chichester, UK: John Wiley & Sons.