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Effect of Levels of Black Cumin Seed on Quality Properties of Mish

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Abstract

The effect of levels of black cumin seed (Nigella sativa L.) on the quality of the mish was studied. Mish was manufactured from cow milk, starter culture and black cumin (0.0%, 0.1, 0.5 and 0.8%) were added , The final product was stored in a refrigerator (7±2°C) and the tests were taken at intervals of 0, 10, 20 and 30 days.

Chemical analysis of mish products showed that the highest content of total solids was (29.85%), protein (11.80%), fats (13.00%), ash (2.95%) and fiber content (2.10%), in sample containing 0.8% of black cumin seed. The titratable acidity increased with increasing levels of black cumin and increased during the storage period, while the pH value decreased.

The minerals content increased significantly (P≤ 0.05) with increasing the concentration of cumin compared to the control sample, where the highest calcium content (315.66mg/100g), potassium (280.15mg/100g), phosphorus (233.60mg/100g), magnesium (165.11 mg/100g), Sodium (115.35 mg/100g) and iron (5.90 mg/100g), in sample containing 0.8% cumin. The total count of bacteria decreased by increasing the levels of black cumin compared to the control sample, while there were no growths of coliform bacteria, staphylococcus aureus, mould and yeast.

The results of the sensory evaluation showed that the sample containing 0.5% cumin recorded the best score of appearance (4.8), texture (4.7), flavour (4.9) and overall acceptability (4.8) compared to other sample.

Keywords: Mish, Black cumin seed, Quality

INTRODUCTION:

Fermented milk products are cultured dairy products made from skim, whole or slightly concentrated milk that require specific lactic acid bacteria to develop their characteristic flavor and texture (Thapa, 2000).

Many traditional fermented milk products are made in Asia, Africa, the Middle East and northern and eastern Europe. The microbiological characteristics of several fermented milk products have been studded in the .world (Keller and Jordan; 1990, Beukes *et al.,* 2001).

Food fermented has a long history in Africa and relies on indigenous knowledge of the majority of the population , only seldom are fermentation processes fully industrialized and many food production fermentation still occur at the household -scale or at small enterprise scale (Mathara *et al.,* 2004).

The nature of fermented products is different from one region to another. Thus is depending on the local indigenous microfloras, which in turn reflect the climatic condition of the area (Savadogo *et al*., 2004).

Many people throughout Africa enjoy soured milk products. In these products, the lactic acid bacteria perform an essential role in preserving a highly nutritious food product. Fermented milk products are also of great significance for their therapeutic value, for alleviating lactose intolerance, social value and as a means of generating income (Beukes *et al*., 2001).

Mish is a fermented milk product, which likes other dairy products such as cheese, yoghurt, butter and cream, is manufactured in Sudan as well as in many other countries (Dirar, 1993; Abdalla and Abdel Nabi, 2010). Mish is fermented food almost know to all regions of Sudan and may be similar product but in different names (El-mardi, 1988). As well as the beneficial role of plant-based commodities against lipid peroxidation has been established through many scientific studies; advocating the importance of a higher consumption of phytochemicals in the promotion of health (Enayde *et al.,* 2006; Hameed *et al.,* 2019).

The seed of *Nigella sativa* (*N. sativa*) has been used in different civilization around the world for centuries to treat various animal and human ailments. So far, numerous studies demonstrated the seed of *Nigella sativa* and its main active constituent, thymoguinone, to be medicinally very effective against various illnesses including different chronic illness: neurological and mental illness, cardiovascular disorders, cancer, diabetes, inflammatory conditions, and infertility as well as various infectious diseases due to bacterial, fungal, parasitic and viral infections. In spite of limited studies conducted so far, the promising efficacy of *N. sativa* against HIV/AIDS can be explored as an alternative option for the treatment of this pandemic disease after substantiating its full therapeutic efficacy (Ebrahim *et al*., 2019).

The objective of this study was to evaluate the effect of level of black cumin seed on quality of mish.

MATERIALS AND METHODS

Materials

Source of milk: The fresh cow' s milk used in the manufacture of mish in this experiment was obtained from University of Khartoum Farm, black cumin seed from local market Khartoum, Sudan.

Mish Manufacture: The milk was pasteurized at 85˚C for 10 minutes, and then cooled to 45^0C. Starter culture at a rate of 5% of the milk volume was added in the forms of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* and black cumin seed were added to the product at levels of 0.0, 0.1, 0.5 and 0.8%. The samples placed into 250ml cups and kept in an incubator at 45˚C for 3- 4 hours. The cups were transferred to refrigerator and stored in a temperature of 7±2˚C for 0, 10, 20 and 30 days intervals. Analyses were carried out for physico-chemical, minerals, microbiological and organoleptic qualities.

Methods

Chemical analyses of mish

The chemical composition of mish was determined as follows:

Total solids, protein, fat, ash, titratable acidity and fiber contents were determined according to the modified Method of AOAC

(2003). The pH value was determined by using digital pH-meter model A0056H Germany.

Minerals content

Minerals content (Ca, k, P, Mg, Na and Fe) were determined according to Atomic Absorption Spectrometer (Elemer, 1994).

Microbiological examination

Total viable count (TBC): The plate count agar medium was used for the determination of total bacteria count according to Houghtby *et al*. (1992). The medium has the following ingredients:

Yeasts and moulds: The count was performed according to Frank *et al*. (1992) using potato dextrose agar (PDA).

Coliform bacteria: The count was performed according to Christen *et al;* (1992) using MacConkey agar medium.

Staphylococcus aureus: The count was performed according to Flowers *et al*., (1992) using Baird Parker agar base.

Sensory Evaluation

Ten untrained panelists from the Department of Food Science and Technology, Al-Zaeim Al-Azhari University, were chosen to judge on the quality of mish in term of appearance, flavour, texture and overall acceptability (Ihekoryne and Ngoddy , 1985).

Statistical analysis

The data was analyzed using statistical SAS (1997). Data generated were subjected to SAS version 9.2 issued in 2014 by Microsoft Corporation, and then means were separated using DMRT.

RESULTS AND DISCUSSION

Physicochemical properties of mish

Total solids content

Table.1 shows the effect of levels of black cumin on total solid content of mish. The highest total solid (29.85%) was obtained by sample containing 0.8% black cumin. The lowest (18.11%) by the control sample while the other samples ranked in an intermediate position

(P≤0.05). The total solid increased with increasing levels of black cumin. Variation of chemical contents of mish samples were reported by Osman (1987) who stated that the range of moisture was 70 – 80%, total solids content were 20 – 30%. Nassib and El Gendy (1974) reported that the Egyptian Mish contain 17.6 – 47.5% total solids. Chemical analysis for Mish samples revealed 11.83, value total solid (El Zubeir *et al.*, 2005).

Protein content

Table.1Shows the effect of levels of black cumin on protein content of mish. The highest protein content (11.80%) was obtained by sample containing 0.8% black cumin. The lowest (8.14%) by the control samples while the other samples ranked in an intermediate position (P≤0.05). The protein content increased with increasing levels of black cumin.

Chemical analysis for Mish samples revealed 5.09 for protein (El Zubeir *et al.*, 2005).

Abdel-Gader, (2008) showed that the protein percentages recorded in modern method- Mish were 10.26, 9.2% and 10.7% for mean, minimum and maximum values, respectively. The mean value of protein in traditional method-mish was 7.9% with a minimum of 7.6 % and 9.0% as maximum value. The results were higher than those reported by El Zubeir *et al,* (2005). They reported that protein of Mish was 5.09%. However, the mean reported for Mish in the present study was similar to the result reported by Nassib and El- Gendy (1974). The high protein means obtained for the Mish samples from company used modern method might be due to the high T.S content of the mix used during the manufacturing of the product. Yimer *et al*., (2019) stated that the nutritional composition reported from different sources revealed 20-85% of protein. Moreover the protein content was found to be 7.0 % in commercial mish samples and 8.0 in capo mish samples (Abdel Moneim *et al*., 2011).

Fat content

Table.1Shows the effect of levels of black cumin on fat content of mish. The highest fat content (13.00%) was obtained by sample containing 0.8% black cumin. The lowest (7.00%) by the control sample while the other samples ranked in an intermediate position (P≤0.05). The fat content increased with increasing levels of black cumin. Chemical

analysis for mish samples revealed 2.83 for fat content (El Zubeir *et al.*, 2005).Abdel-Gader, (2008) showed that the mean fat value was 6.98% for mish produced by the modern method and the minimum was 6.5% and the maximum was 7.2%, while the mean fat value in traditional method-mish was 5.89% and the minimum was 5.2% and the maximum was 6.5% which were higher than the results reported by Nassib and El-Gendy (1974) and El Zubeir *et al.* (2005) for mish. Yimer *et al*., (2019) found that the maximal nutritional value of black cumin can be linked to the presence of substantial amount of vegetable protein, fiber and minerals, and vitamins. The nutritional composition reported from different sources revealed 38.20% of fat. Moreover the fat content was ranged to be 6.2% to 7.13% in commercial mish samples (Abdel Moneim *et al*., 2011).

Ash content

Table.1 Show the effect of levels of black cumin on ash content of mish. The highest ash content (2.95%) was obtained by sample containing 0.8% black cumin. The lowest (1.95%) by the control sample while the other samples ranked in intermediate position ($p \leq 0.05$) .The ash content increased with increasing levels of black cumin. The ash content was ranged to be 1.41% to 1.99% in commercial mish samples (Abdel Moneim *et al*., 2011).

Fiber content

Table.1Shows the effect of levels of black cumin on fiber content of mish .The highest fiber content (2.10%) was obtained by sample containing 0.8% black cumin. The lowest (0.0%) by the control sample. While the other samples ranked in an intermediate position ($p \leq 0.05$). The fiber content increased with increasing levels of black cumin. Yimer *et al*., (2019) stated that the maximal nutritional value of black cumin can be linked to the presence of substantial amount of fiber reported from different sources revealed 7-94%.

Table 1: Effect of levels of black cumin on physicochemical analysis (%) of mish

Item	Level of black cumin (%)			
	0.0 %	**0.1%**	**0.5%**	**0.8%**
Total Solid	$18.11^{d} \pm 0.25$	$23.05^{c} \pm 0.26$	$26.60^{b} \pm 0.23$	$29.85^{a} \pm 0.24$
Protein	$8.14^{c} \pm 0.16$	$8.90^{c} \pm 0.18$	$10.45^{b} \pm 0.17$	$11.80^{a} \pm 015$
Fat	$7.00^{d} \pm 0.08$	$9.80^{c} \pm 0.06$	$11.55^{b} \pm 0.03$	$13.00^{a} \pm 0.04$
Ash	$1.95^{c} \pm 0.07$	$2.50^{b} \pm 0.09$	$2.70^{ab} \pm 0.05$	$2.95^{a} \pm 0.02$
Fiber	$0.00^{d} \pm 0.00$	$1.22^{c} \pm 0.02$	$1.65^{b} \pm 0.04$	$2.10^{a} \pm 0.03$

Mean ± SD. having different superscript letter on row are significantly different ($p \leq 0.05$).

PH value

Table.2 shows the effect of levels of black cumin seeds on pH value of mish during storage period. The highest pH value (4.9) was obtained by the control sample. The lowest (3.5) by the sample containing 0.8% black cumin, while the other samples ranked in an intermediate position ($p \leq 0.05$). The pH value of mish decreased with increasing levels of black cumin. The storage period significantly ($P \leq 0.05$) affected the pH value of mish. The highest pH value was obtained at the beginning of the storage period while the lowest at the end. The pH value of black cumin mish samples showed decreasing trend as the storage period progressed.

Variation of chemical contents of mish samples were reported by Osman (1987) who stated that the range of pH value was3.5 – 4.0.Nassib and El Gendy (1974) reported that the Egyptian Mish contain 5.2 – 7.18 pH value.El Zubeir *et al.*, (2005). found that, the minimum, maximum and mean values of pH for modern method-Mish were 3.0 - 4.22 and 3.949, while in traditional method samples the values were 3.77 - 3.98 and 3.895, respectively. These results were similar to those reported by Osman (1987). However, they were lower than that reported by Nassib and El-Gendi (1974). Moreover the pH value was ranged to be 4.45% to 4.49% in commercial mish samples (Abdel Moneim *et al*., 2011).

Titratable acidity

Table.2 shows the effect of levels of black cumin on titratable acidity of mish during storage period. The highest titratable acidity (3.0%) was obtained in sample containing 0.8% black cumin. The lowest (1.7%) by the control sample. The titratable acidity increased with increasing levels of black cumin.

The storage period significantly (P≤0.05) affected the titratable acidity of black cumin mish. The lowest titratable acidity was obtained at the beginning of the storage while the highest at the end (p≤0.05).

Chemical analysis for mish samples revealed 1.24% for lactic acid (El Zubeir *et al.*, 2005).

A mean of 2.334 % for samples produced by modern method company that ranging between 2.277% and 2.349% were more or less similar to 2.352% for the sample collected from company used traditional method which ranging between 2.313 % and 2.367% (Abdel-Gader, 2008). These results were higher than that reported by El Zubeir *et al.* (2005) who found titratable acidity to be 1.243% in mish samples produced by Butana dairy company.

Moreover the acidity was ranged to be 1.5% to 2.00% in commercial mish samples (Abdel Moneim *et al.*, 2011).

Table 2: Effect of levels of black cumin on pH values and titratable acidity (%) of mish

Storage period (days)	PH				Acidity			
	Level of black cumin (%)				Level of black cumin (%)			
	0.0 %	0.1%	0. 5%	0. 8%	0.0 %	0. 1%	0. 5%	0. 8%
0	4.9^{a}±0.01	4.7^{b}±0.02	4.3^{d}±0.05	4.1^{e}±0.08	1.7^{k}±0.26	2.0^{j}±0.12	2.3^{h}±0.14	2.60^{e}±0.15
10	4.4^{c}±0.05	4.3^{d}±0.06	4.1^{e}±0.09	3.8^{h}±0.11	2.1^{i}± 0.23	2.3^{h}±0.18	2.6^{e}±0.17	2.8^{c} ± 0.21
20	4.1^{e}±0.07	4.0^{f}± 0.08	3.9^{g}±0.12	3.7^{i}±0.13	2.4^{g}±0.19	2.5^{f}±0.16	2.7^{d}±0.11	2.9^{b}± 0.13
30	3.9^{g}±0.08	3.7^{i}± 0.05	3.5^{j}±0.06	3.5^{k}±0.09	2.6^{e}±0.27	2.7^{d}±0.25	2.8^{c}±0.19	3.0^{a} ± 0.22

Mean ± SD. having different superscript letter on columns and rows are significantly different (p ≤ 0.05).

Minerals content of mish

Table.3 shows the effect of levels of black cumin seeds on minerals content of the mish. The highest calcium (315.66 mg|100g), Potassium (280.15 mg|100g), Phosphorus (233.60 mg|100g), Magnesium (165.11 mg|100g), Sodium (115.35 mg|100g) and Iron (5.90 mg|100g) were recorded in sample containing 0.8% black cumin in while the lowest (155.24, 43.50, 87.60, 18.80, 32.35 and 0.65 mg|100g) respectively in control sample (P≤ 0.05).

The minerals content increased with increasing levels of black cumin. The black cumin seeds also contain significant levels of calcium (Takruri and Dameh, 1998; Ramadan, 2007; Ateteallah and Hassan, 2017; Gorska-Warsewicz *et al.*, 2019; USDA, 2019).

Gorska-Warsewicz *et al.*, (2019) found that, the average potassium content in yoghurts milk drinks and other dairy products were 385mg. According to our research, the share of milk and dairy

products in the supply of potassium is almost 12%, with a significant share of milk. In the American diet, the share of milk in potassium supply is 9.6% (O'Neil *et al*., 2012). Moreover the potassium content in black cumin seed was 1788 g|100g (USDA, 2019). Atta (2003) found that the seed has the mineral composition was 0.79% K.

Gorska-Warsewicz *et al*., (2019) found that, the average phosphorus content in yoghurts, milk drinks and other dairy products were 285.64mg. The phosphorus content increased with increasing levels of black cumin. The black cumin seeds also contain significant levels of phosphorus (Takruri and Dameh, 1998; Ramadan, 2007). Moreover the phosphorus content in black cumin seed was 499g|100g (USDA, 2019).

Atta (2003) found 0.25% magnesium in mish samples. The average concentration of Na in the mish samples was 19100-32800ppm showed by Ateteallah and Hassan,(2017). The sodium content in black cumin seed was 168 mg|100g , while the magnesium content was 366g |100g (USDA, 2019).

The black cumin seeds also contain significant levels of iron (Takruri and Dameh, 1998; Ramadan, 2007). These mineral is important for the normal function and growth of the body. Generally the average iron content in milk drinks and other dairy products were 0.56mg|100g (Gorska-Warsewicz *et al*., 2019).

Table 3: Effect of levels of black cumin on minerals content (mg | 100g) of mish

Minerals	Level of black cumin (%)			
	0.0 %	0.1%	0.5%	0.8%
Calcium	$155.24^{d} \pm 0.27$	$217.80^{c} \pm 0.29$	$288.10^{b} \pm 0.28$	$315.66^{a} \pm 0.26$
Potassium	$43.50^{d} \pm 0.09$	$175.50^{c} \pm 0.12$	$205.34^{b} \pm 0.14$	$280.15^{a} \pm 0.13$
Phosphorus	$87.60^{d} \pm 0.11$	$145.66^{c} \pm 0.18$	$195.77^{b} \pm 0.15$	$233.60^{a} \pm 0.16$
Magnesium	$18.80^{d} \pm 0.08$	$86.40^{c} \pm 0.05$	$140.20^{b} \pm 0.07$	$165.11^{a} \pm 0.04$
Sodium	$32.35^{d} \pm 0.06$	$75.11^{c} \pm 0.07$	$95.40^{b} \pm 0.06$	$115.35^{a} \pm 0.05$
Iron	$0.65^{c} \pm 0.03$	$4.18^{b} \pm 0.04$	$4.80^{b} \pm 0.02$	$5.90^{a} \pm 0.09$

Mean ± SD. having different superscript letter on row are significantly different ($p \leq 0.05$).

Microbial Content of mish

Table.4. shows the effect of levels of black cumin seeds on total bacterial count of mish. The highest total bacterial count (9.8×10^{4}) was obtained by the control sample, while the lowest (1.5×10^{2}) by the samples containing 0.8% black cumin. The total bacterial count of

mish decreased with increasing levels of black cumin. The Coliforms count, Staphylococcus aureus, Mould and yeast count were recorded nil.

The presence of some pathogens in the dairy products *(E. coli,* S. *aureus*, yeast and mould) during different processing procedures indicated the lower standards of hygiene in the selected dairy factory. This could be due to the traditional method of distribution of milk to consumers, retailers and factories, which were transported into large plastic containers that still practiced in Sudan. Among the inspiring medicinal plants, black cumin is the one that displayed strong antibacterial, antifungal, antiviral, and ant parasitic actions (Yimer *et al*., 2019).

In addition, those containers are opened frequently that milk is subjected to contamination (Murphy and Boor, 2000). It might also be due to unrefrigerated transportation of milk from dairy farms, through collection centers, to the major processing plant may have been responsible for the high counts of *E.coli* and S. *aureus* in milk (Asperger *et al.,* 1994).

The mean log count of *Escherichia coli, Staphylococcus aureus,* in whole milk demonstrated that raw milk could be a source of pathogenic bacteria (Giovannini, 1998). The presence of pathogenic organisms in samples could be due to unhygienic conditions on practice during production or may be due to inadequate cleaning of utensils (Jay, 1986). Similarly, inadequately sanitized milk utensils are the most common sources of coliform in raw milk (Murphy and Boor, 2000).

Table 4: Effect of levels of black cumin on total bacterial count (cfu| ml) of mish

Type of Microbes	Level of black cumin (%)			
	0.0 %	**0.1%**	**0.5%**	**0.8%**
Total Bacterial Count	9.8×10^{4}	3.2×10^{4}	5.2×10^{3}	1.5×10^{2}

Organoleptic quality

Table. 5 shows the effect of levels of black cumin seeds on organoleptic quality of mish. The best Appearance (4.8), Texture (4.7), Flavour (4.9) and Overall acceptability (4.8) were obtained by sample 0.5% black cumin while the worst by the control sample ($p\leq0.o5$)

The storage period significantly (P≤0.05) affected the organoleptic quality of mish. The best organoleptic quality was obtained at day 20 processing while the worst score at the end of the storage period.

These results were similar to those found by Hassanein *et al*., (2013). Spices have a definite role to play in enhancing the taste and flavour of any food and are believed to have medicinal value. They have been used in a large number of medicinal preparations for the treatment of several disorders, particularly of the digestive system (Muthamma *et al*., 2008). The black cumin seeds (*Nigella Sativa* L.), contain more than hundred different volatile components depending on the way and the region of cultivation (Khan, 1999, Paarakh, 2010). Cumin's distinctive flavour and strong warm aroma is due to its essential oil content (Li and Jiang, 2004).

CONCLUSION

The study concluded that producing mish with addition 0.5% black cumin seed caused an increase in nutritional value, minerals, antimicrobial resistance and improved the sensory properties of final product.

REFERENCES

1. Abdalla, M. O. M. and Abdel Nabi, S. Z. (2010). Chemical composition of mish "A traditional fermented dairy Product" from different Plants during storage. *Pakistan Journal of Nutrition* 9 (3): 209-212.
2. Hadeel Abd Elgadir, O. and Elamin Elkhalif, A.(2011).Chemical and Microbiological Characteristics of Fermented Milk Product, Mish.International Journal of Food Science and Nutrition Engineering , 1(1): 1-4
3. Abdel-Gader, M. K.H. (2008). Quality evaluation of the commercial mish in Khartoum State, Sudan.B.Sc. Honours (Animal Production Science and Technology) Sudan University of Science and Technology
4. AOAC (2003). Official methods of analysis, 15thed. Association of Official Analytical Chemists, Washington Dc, USA.
5. Asperger, H.; Beker, G.; Vlaemynck, M. R. and Fleming, M.G. (1994). Staphylococcus aureus. In: the Significance of Pathogenic Microorganisms in Raw Milk. *International Dairy Federation (IDF). Belgium*.
6. Ateteallah, H. A. and Hassan, M. F. (2017). Assessment of Sodium, Calcium and Potassium in Buffalo's Raw Milk and its Rural Products in some centers

of Sohag Governorates, Mansoura Univ *Egypt. J. Food and Dairy Sci*.,., 8 (8): 331 - 334

7. Atta, M. B. (2003). Some characteristics of nigella (*Nigella sativa* L.) seed cultivated in Egypt and its lipid profile. *Food Chem., **83***: 63–68.
8. Beukes, E. M.; Besterm B.H. and Moster, J. F. (2001). The microbiology of South African traditional fermented milk. *Int. J. Food Microbiol*., 63: 189-197.
9. Christen, L. G.; Davidson, P. m.; McAllister, J. S. and Roth, L. A. (1992). Coliform and other indicator bacteria. In Standard Methods for the Examination of Dairy Products, 16th edition, Ed., R.T. Marshall. Washington, DC: American Public Health Association, pp: 247 – 269.
10. Dirar, H. A. (1993). Gariss. Dairy products. The Indigenous Fermented Foods of the Sudan. A study in African Food and Nutrition. CAB International, Wallingford, UK .
11. Ebrahim, M.; Tuem, Y.K.B.; Karim, A.; Ur-Rehman, N. and Anwar, F.(2019). *Nigella sativa* L. (Black Cumin): A Promising Natural Remedy for Wide Range of Illnesses. Evid Based Complement Alternat Med:1528635
12. El Zubeir, I. E. M.; Abdalla Wigdan. M and ElOwni, O. A. O. (2005). Chemical composition of fermented milk (Rob & Mish) in Sudan. *Food Control*, 16: 633 – 637.
13. Elemer, P. (1994). Analytical Method for Atomic Adsorption spectroscopy. Perkin Elemer, London.
14. El-mardi, M. M. (1988). Astudy on fermented milk "roub". M.Sc. Thesis, University of Khartoum, Sudan.
15. Enayde, D.A.; Lima, V.; Maciel, M. (2006). Polyphenol Ascorbic Acid and Total Carotenoids Content in Common Fruit and Vegetables. *Brazilian J. of Food Tech*. 9(2), 89–96.
16. Flowers, S. R.; Andrewes, W.; Donnelly, C. W. and Koening, E. K. (1992). Pathogens in Milk and Milk products, In Standard Methods for the Examination of Dairy products, 16th edition, Ed., R. T. Marshal. Washington, DC: American public Health Association, pp 103-212.Fox.
17. Frank, F. J.; Christen, L. G. and Bullerman, L. B. (1992). Tests for groups of microorganisms. In Standard Methods for the Microbiological Examination of Dairy products, 16th edition. Ed., R. T. Marshall. Washington, DC: American puplic Health Association, pp: 271-286.
18. Giovannini, A. (1998). Importance of milk hygiene to public health. MZCP, Workshop on the Management of Milk Borne Zoonoses Surveillance and Control in the MZCP Countries. Cephalania Island, Greece, 1-2.
19. Gorska-Warsewicz, H.; Laskowski, W.; Rejman, K. and Czeczotko. M. (2019). Milk and Dairy Products and Their Nutritional Contribution to the Average Polish Diet. *J. Nutrients* 11: 1771.
20. Hameed, S.; Imran, A.; Nisa, M.; Arshad, M. S.; Saeed, F.; Arshad, M.U. and Khan, M. A. (2019). Characterization of extracted phenolics from black cumin (*Nigella sativa* linn), coriander seed (*Coriandrum sativum* L.), and fenugreek seed (*Trigonella foenum-graecum*), *International Journal of Food Properties*, 22:1, 714-726,
21. Hamid, O. I. A. (2014). Effect of cumin oil concentrations on chemical composition and sensory characteristics of Sudanese white cheese during ripening. *Int. J. Curr. Microbiol. App. Sci* 3(4) : 961-968

22. Hassanein, M.F.R., Mahgoub, S.A. and El- Zahar, K.M. (2013). Soft cheese supplemented with black cumin oil: Impact on food borne pathogens and quality during storage. *Saudi Journal of Biological Sciences* vol: 20
23. Houghtby, G. A.; Maturin, L. J. and Koenig, E. K. (1992). Microbiology count methods. In: "Standard methods in examination of dairy products". Marshal, R. T. (ed), 16th edition, port City press, Baltimore, Washington.
24. Ihekorone, A. I. and Negoddy, P.O. (1985). Integrated food since and technology for the tropics. Mac. Millan. Pub. London.
25. Keller, J.J. and Jordan, I. (1990). Fermented milks for the South African market. *South Afr. J. Dairy Sci*., 22: 4749.
26. Khan, M. A. (1999). Chemical composition and medicinal properties of Nigella sativa Linn. Inflammo pharmacology, 7: 15 35
27. Kokdil, G.; Dlcim, A.; Ozbilgin, B. and Uygun, C. (2006). Morphology and stem anatomy of some species of genus Nigella L. in Turkey. *Journal of Faculty of Pharmacy of Ankara*. 35(1):19–41.
28. Li, R and Jiang, Z.-T., (2004). Chemical composition of the essential oil of Cuminum cyminum L. from China. *Flavour and Fragrance Journal* 19:311 - 313.
29. Manie, T.; Brozel, V. S.; Veith, W. F. and Gouws, P.G. (1999). Antimicrobial resistance of bacterial flora associated with bovine products in *South Africa. J. Food Prot*. 62: 615-618.
30. Mathara, J. M.; Schillinger, U.; Kutima, P. M.; Mbugua, S. K. and Holzapfel, H. W. (2004). Isolation, identification and characterization of dominant microorganisms of kule naoto: the Maasai traditional fermented milk in Kenya. *Int. J. Food Microbiol*., 94: 269-278.
31. Murphy, S. C. and Boor, K.J. (2000). Trouble-shooting sources and causes of high bacteria counts in raw milk. *Dairy Food Environ. Sanit*. 20: 606-611.
32. Muthamma, M. K.S.; Hemang, D.; Purnima, K.T. and Prakash, V. (2008). Enhancement of digestive enzymatic activity by cumin (Cuminum cyminum L.) and role of spent cumin as a bionutrient. *Food Chemistry* 110, 678 6
33. Nassib, T. A. and El-Gendy, S. M. (1974). Chemical and microbiological studies on Mish. *Annals of Agricultural Science Moshtohor* 1 : 149– 158.
34. O'Neil, C. E.; Keast, D. R.; Fulgoni, V. L. and Nicklas, T. A. (2012). Food sources of energy and nutrients among adults in the US: NHANES 2003-2006. *Nutrients*, 4, 2097–2120.
35. Osman, O. A. (1987). The technology of Sudanese white cheese "Gibna Bayda" Internaional Dairy Federation, Bulletin No. 221/1987.
36. Paarakh, P. (2010). Nigella Sativa Linn - A comprehensive review. 2010. Indian Journal of Natural Products and Resources, 1(4): 409-429.
37. Ramadan, M. F. (2007). Nutritional value, functional properties and nutraceutical applications of black cumin (Nigella sativa L.): an overview. *International Journal of Food Science & Technology*, 42(10):1208–1218
38. SAS (1997). User's guide: Statistic version 4-0. Inst., Inc. Cary. N.C.
39. Savadogo, A.; Ouattara, C. A.T.; Savadogo, P.W.; Barro, N. and Traore, A. S. (2004). Microorganisms involved in fulani traditional fermented milk in Burkina Faso. *Pak. J. Nutr*., 3: 134-139

40. Takruri, H. R. H. and Dameh M. A. F. (1998). Study of the nutritional value of black cumin seeds (Nigella sativa L) *Journal of the Science of Food and Agriculture*. ; 76 (3):404–410.
41. Thapa, T. B. (2000). Small scale milk processing technology: Other milk products. An electronic conference. Food and Agriculture Organization of the United Nations, Rome, Italy.
42. USDA (2019). Spices black cumin seed nutrient. Data Type: SR Legacy Food Category: Spices and Herbs FDC ID: 171324
43. Yesuf, Y. K. (2018). Growth and health promoting effects of nigella sativa l., trigonella foenum-graecum l. and curcuma longa l. in broiler chicken. A Dissertation Submitted to the College of Veterinary Medicine and Agriculture, Addis Ababa University in Fulfillment of the Requirement of the Degree of Doctor of Philosophy in Animal Production
44. Yimer, E.M.; Tuem, K.B.; Karim, A.; Ur-Rehman, N. and Farooq Anwar, F. (2019). *Nigella sativa* L. (Black Cumin): A Promising Natural Remedy for Wide Range of Illnesses. Evid Based Complement Alternat Med.

Table 5: Effect of levels of black cumin on organoleptic quality of mish

Storage period (days)	Appearance				Texture				Flavour				Over all acceptability			
	Level of black cumin				Level of black cumin				Level of black cumin				Level of black cumin			
	0.0 %	0.1%	0.5%	0.8%	0.0 %	0.1%	0.5%	0.8%	0.0 %	0.1%	0.5%	0.8%	0.0 %	0.1%	0.5%	0.8%
0	3.7^{k} ± 0.13	4.1^{b} ±0.09	4.2^{g} ±0.08	3.9^{j} ± .11	3.4^{j} ±0.05	4.1^{f} ±0.08	4.3^{d} ±0.07	4.0^{g} ±0.11	3.7^{j} ± 0.08	4.2^{f} ±0.07	4.4^{d} ±0.04	4.0^{h} ±0.08	3.6^{k} ±0.08	4.2^{g} ±0.07	4.5^{d} ±0.02	4.0^{h} ±0.09
10	3.9^{j} ± 0.12	4.3^{f} ±0.06	4.5^{d} ±0.04	4.1^{h} ±0.08	3.7^{i} ±0.11	4.3^{d} ±0.02	4.4^{c} ±0.05	4.2^{e} ±0.08	3.9^{i} ±0.11	4.4^{d} ±0.04	4.7^{b} ±0.03	4.2^{f} ±0.07	3.8^{j} ±0.09	4.4^{e} ±0.05	4.6^{c} ±0.03	4.2^{g} ±0.07
20	4.2^{g} ± 0.08	4.6^{c} ±0.03	4.8^{a} ±0.01	4.4^{e} ±0.05	4.0^{g} ±0.09	4.5^{b} ±0.04	4.7^{a} ±0.03	4.3^{d} ±0.06	4.1^{g} ±0.09	4.7^{b} 0.02	4.9^{a} ±0.01	4.5^{c} ±0.04	4.0^{h} ±0.06	4.6^{c} ±0.04	4.8^{a} ±0.01	4.5^{d} ±0.03
30	4.0^{c} ± 0.09	4.4^{e} ±0.04	4.7^{b} ±0.02	4.2^{g} ±0.07	3.8^{h} ±0.08	4.3^{d} ±0.07	4.5^{b} ±0.02	4.1^{f} ±0.09	4.0^{h} ±0.07	4.4^{d} ±0.05	4.7^{b} ±0.02	4.3^{h} ±0.06	3.9^{i} ±0.11	4.4^{e} ±0.06	4.7^{b} ±0.02	4.3^{f} ±0.08

Mean ± SD. having different superscript letter on rows and columns are significantly different ($p \leq 0.05$).