

Original Research Article

Calcium and Magnesium Rich Cookies, Fortified with Pumpkin (*Cucurbita moschata*) and Sunflower Seed (*Helianthus annus L.*)

Abstract

The study of cookies development was carried out at the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara. The main objective of the study was to develop cookies. The main goal of the study was to develop cookies which provides enough calcium and magnesium which found in pumpkin and sunflower seeds and which are rich in antimicrobial and antioxidant property and rich in protein. Cookies were developed by using pumpkin and sunflower seed flour which was first grounded and grind into powder and combined with wheat flour and other ingredients are butter and sugar were used. The pumpkin and sunflower flour and wheat were taken into different variation during dough preparation. The dough was prepared first and sheeting of dough and making shape with shaper and cookies were made. Five different formulations T₁, T₂, T₃, T₄, T₅ and T₀ were prepared. T₄ was found to be the best formulation after sensory evaluation with 9 Point Hedonic Scale. Then developed cookies were further analyzed for sensory evaluation. The cookies showed 14.2 % of moisture content, 2.4% Ash content, 13.62g protein content, 36.25 g fat content, 46.97 % carbohydrates content, 0.76 g fibre and energy value 563.57 kcal/ 100 g. The Fourier transform infrared spectroscopy (FTIR) of developed cookies shows spectra 3301.74 cm⁻¹ which represent O-H group, 2927.81 and 2859.54 cm⁻¹ are observed which shows C-H group in developed cookies. The developed cookies were packed in polyethylene pouches (PEP), and stored under ambient (18-38 °C) and refrigeration temperature (4°C) conditions for 3 months. The moisture content of the cookies significantly increased from 14.2 to 14.44 per cent. Ash, fat and protein decreased to 2.4 to 2.24 per cent, 36.25 to 36.11 per cent and 13.62 to 13.51 per cent, respectively. At refrigeration temperature, the rise in moisture from 14.2 to 14.27 per cent. In addition, the amount of fat, protein, and ash fell from 36.25 to 36.19 per cent, 13.62 to 13.13.56 per cent, and 2.4 to 2.36 per cent, respectively. Thus, it shows that refrigeration temperature is best storage temperature and it retain nutrients.

Keywords: Cookies, FT-IR, Pumpkin Seed, Sunflower Seed.

1. INTRODUCTION

It makes sense to enrich food products to address certain nutritional deficiencies. Food enrichment improves human health and helps prevent chronic diseases. Nutritionists face technical and scientific hurdles in the identification and development of enriching agents that would ensure optimum product

quality and increase the bioavailability of vital nutrients (Revathy and Sabitha, 2013). Fortification is a technique that can be used to treat or prevent widespread nutrient deficits and, as a result, corrects associated micronutrient deficiencies. Fortification can be used to control the complete nutritional profile of diets, recover nutrients destroyed in food processing, or produce goods more appealing to consumers. The nutritional content of refined grains can be restored by enriching them with elements, which recover the nutrients dropped while processing (thiamine, niacin, riboflavin, and iron) (Rosenberg *et al.*, 2004). Due to their widespread use, baked goods are seen to be the greatest option for enhancing refined wheat products that contain high protein oilseed flour (Hoover, 1979). Cookies are goods manufactured from wheat flour, oil, milk powder, salt, sugar, water, and a few minor ingredients like as sodium bicarbonate, ammonium bicarbonate, and emulsifiers to improve the colour, flavour, texture, and consistency (Manley, 1998). Because of its low cost, simplicity, shelf stability, and nutritious content, it has become a favourite snack meal for both young and old people (Akubor, 2003).

The Cucurbitaceae is the family that includes pumpkin. A plant that has historically been used as medicine in underdeveloped nations has seen a resurgence in popularity in the Europe and the United States (Caili, Huan and Quanhong, 2006). *Cucurbita*, also known as "pumpkin," is a trailing plant that is grown from sea level to high altitudes (altitudes) (Yadav *et al.*, 2010). China and India are the world's major pumpkin producers, accounting for 48.42% (nearly 11 million tons per year) of total pumpkin production. Over 90% of total production in these countries is used for oil extraction, leaving a significant amount of residue as pumpkin powder, which provides 60-70% protein (Lazos, 1992). The plant's blooms, fruit, leaves, roots, and seeds are all edible components. Due to their high nutritional content and medicinal qualities, pumpkin seeds are utilized for therapeutic purposes throughout the world. In Arab nations, pumpkin seeds are frequently consumed as a snack after being roasted and salted (Al-Khalifa, 1996). Pumpkin seeds are regarded as valuable oil seeds packed with protein sources and are a high natural source of proteins with a range of 25 to 37% and oil with a range of 37 to 45% (Milovanovic and Vucelic-Radovic, 2008). Additionally, a great source of fibre, these seeds, 31.48% of them are crude fibre (Nyam, Lau and Tan, 2013). Additionally, because pumpkin seeds are high in iron and amino acid like tryptophan, lysine, methionine, and tyrosine, they are helpful to adolescents in treating anaemia brought on by iron deficiency (El-Adawy and Taha, 2001; Patel, 2013). Furthermore, pumpkin seeds are high in magnesium, potassium, and phosphorus, as well as other trace minerals including zinc, manganese, iron, calcium, sodium, and copper. (Amin, 2019; Koh, 2018). According to claims, foods enriched with pumpkin are a strong source of anti-inflammatory ingredients, which can help with a variety of illnesses including arthritis (Fahim *et al.*, 1995).

Sunflower is one of the three most widely produced oil crops in the world (*Helianthus annuus* L.) (Yegorov *et al.*, 2019). Turkey is one of the world's top ten sunflower producing countries. Turkish

Formatted: Font: Italic

Comment [B1]: CHECK THE FONT

Formatted: Font: Italic

sunflower acreage and crop production have recently ranged from 500,000 to 600,000 ha and 650,000 to 950,000 t, respectively. The average sunflower output is approximately 1700 kg ha¹(Kaya, 2004). Oil seed crops have recently attracted attention for their positive impact on health promotion and sickness prevention. Sunflower seeds have also gained popularity due to their important contribution to health (Anjum *et al.*, 2012). Caffeic, chlorogenic, and ferulic acids are three sunflower polyphenols with high antioxidative capability and potential for technical and biological applications (Maier *et al.*, 2009). Sunflower oil is high in both oleic acid (C18:1) and linoleic acid (C18:1). These fatty acids lower the risk of cardiovascular disease by reducing total cholesterol and LDL cholesterol (Chowdhury *et al.*, 2007).

Infrared (IR) or Fourier transform infrared (FTIR) spectroscopy has a wide range of applications, from analyzing tiny molecules or chemical complexes to analyzing cells or tissues. Tissue imaging is a recent advancement in infrared spectroscopy that takes advantage of infrared microscopy and the utilization of synchrotron IR radiation. It is used to identify aberrant cells by mapping cellular components (carbohydrates, lipids, proteins) (Levin and Bhargava, 2005 ; Petibois and Deleris, 2006).

Creating healthier cookies by incorporating various flours and seeds powder can boost the nutritional content of the product. The goal behind including pumpkin and sunflower powder in the cookies is to make them more nutrient-dense and accessible to all. The primary goal of the research is to create nutrient-dense cookies using wheat and seed powder (pumpkin and sunflower).

2. MATERIAL AND METHODS

The Present study entitled “Calcium and magnesium rich cookies, fortified with pumpkin(*Cucurbita moschata*) and sunflower seed(*Helianthus annus* L.)” was carried out in Department of Food Technology, Parul university, Vadodara. This section enlists the material used and elaborate the processing technique, organoleptic evaluation and analytical procedure following during the research.

2.1. Procuring of Raw Materials

The ingredients used in the preparation of the cookies were wheat flour, pumpkin, and sunflower seeds were bought from the Vadodara, Gujarat, neighbourhood market. These vegetable and cereal flours were selected at random and brought to the lab for the current study. Moreover, ingredients like butter and sugar were purchased from the Vadodara, Gujarat, local market.

2.2 . Roasting of seeds

Pumpkin seeds and Sunflower seeds were roasted in an open pan. The seeds were cooked for 2 minutes on a low burner.

2.3. Preparation of flour

After roasting, the seeds were allowed to cool at room temperature. The seeds were then ground individually in a grinder and sieved by hand to produce a fine (uniform) powder.

2.4. Preparation of Cookies.

The ingredients were used to standardize the recipe for cookies.: 25 g of wheat, 25 g sunflower seed powder, 50 g pumpkin seed powder, 30 g sugar and 30 g butter. The components listed above are needed to make 100 g of cookies. The dry ingredients were weighed and combined with cream then the dough was correctly kneaded for 5-10 minutes. The dough was then flattened with a rolling pin and cut into the required form (circular), before being placed cookies in the oven the oven was pre heated for 10 minutes at 180°C. The cookies were then baked for 10 minutes in the oven until they had a smooth texture. The cookies were cool before being placed in polypropylene (PP) pouches. For shelf-life evaluation, the cookies were stored at ambient and refrigeration temperatures.

2.5. Formulations of Cookies.

Table 1 : Formulation of Cookies

Sr no.	Wheat flour (gm)	Pumpkin flour (gm)	Sunflower Flour (gm)	Butter (gm)	Sugar (gm)
T ₀	100	-	-	30	30
T ₁	33.3	33.3	33.3	30	30
T ₂	50	25	25	30	30
T ₃	25	25	50	30	30
T₄	25	50	25	30	30
T ₅	60	20	20	30	30
T ₆	27.5	45	27.5	30	30
T ₇	27.5	27.5	45	30	30
T ₈	45	27.5	27.5	30	30
T ₉	70	15	15	30	30
T ₁₀	15	70	15	30	30
T ₁₁	15	15	70	30	30
T ₁₂	80	10	10	30	30
T ₁₃	10	80	10	30	30
T ₁₄	10	10	80	30	30

T ₁₅	44	28	28	30	30
T ₁₆	28	44	28	30	30
T ₁₇	28	28	44	30	30

Following the above-mentioned varied procedures, numerous flour mixes were standardized. By using sensory evaluation, our professionals, including Dean Sir, institutional faculty, and mentor, chose the best treatment.

UNDER PEER REVIEW

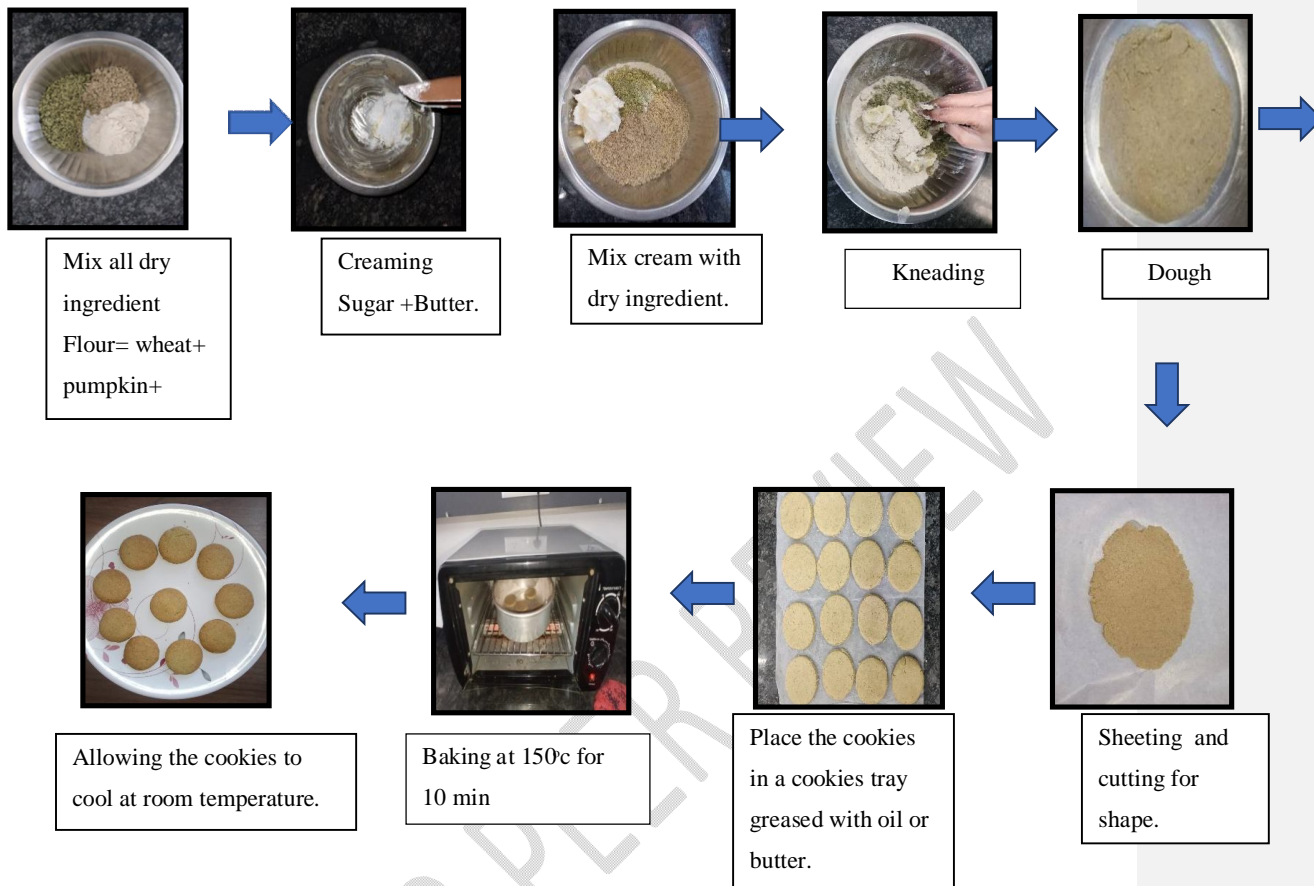


Figure 1-1: Preparation of Cookies.

2.6 Chemical Analysis

Moisture, Ash, Fiber and carbohydrate were determined as per method explained by (Rangana, 2009). Protein and fat were determined by (AOAC, 2012). Energy value determined and measure by bomb calorimeter. Mineral content was determined by (Rajsekaran *et al.*, 2005). Fourier Transform-Infrared Spectroscopy was determined as per method of (Stuart, 2005).

3. RESULT AND DISCUSSION.

The current study, titled " Calcium and magnesium rich cookies, fortified with pumpkin(*Cucurbita moschata*) and sunflower seed(*Helianthus annus L.*)", was carried out in Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara, Gujarat, India during

Formatted: Font: Italic

the years 2023. The results of the study are presented and discussed under different heads and sub heads:

3.1. Proximate Composition of Cookies.

Table 2-2: Chemical Composition of Developed Functional Cookies.

Sr no.	Parameters	Amount (%)
1.	Moisture	14.2
2.	Ash	2.4
3.	Protein	13.62
4.	Energy	563.57 Kcal/100g
5.	Fiber	0.76
6.	Fat	36.25
7.	Carbohydrates	46.97

Table 2 shows Protein, fat, carbohydrate and fibre values are 13.62 per cent, 36.25 per cent, 46.97 per cent, 0.76 per cent respectively. The energy value was 563.57kcal/100g. Ash content was 2.4 per cent and moisture content were 14.2 per cent, respectively. These values closely related to the (Garsa Ali Alshehry, 2020).

Table 3-3: Mineral Content of Developed Functional Cookies

Sr. no.	Minerals	Amount (mg/100g)
1.	Calcium	4.68
2.	Magnesium	37.47
3.	Iron	3.74
4.	Zinc	3.74

Table 3. shows the developed cookies had 37.47 mg/100gm magnesium, 4.68 mg/100gm, 3.74 mg/100gm and 3.74 mg/100gm. (Glew, 2006) who reported similar range of minerals content.

3.2 Fourier Transform – Infrared Spectroscopy (FT-IR).

Fourier Transform Infrared spectroscopy (FT-IR) is a long-wave infrared radiation spectral measurement method that records absorbance in a time field and converts it to a frequency field using the Fourier transform algorithm. Because of its ability to recognize functional groups of chemical

compounds such as carbohydrates, esters, and chemical bonds between atoms, FTIR has been used to analyze a wide range of samples.

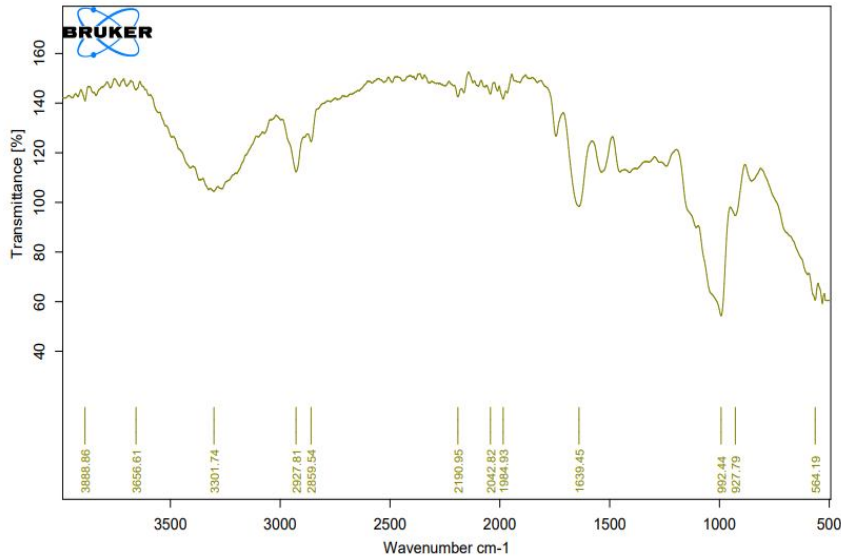


Figure 2:

The results obtained in Figure 1 shows FT-IR spectra at spectra 3301.74 cm^{-1} which represent O-H group, 2927.81 and 2859.54 cm^{-1} are observed which shows C-H group in developed cookies. Similar observation has been recorded by (Sharma., 2020).

3.3 Quality Evaluation of Cookies During Storage

After the product is developed then cookies then packed in to polyethylene pouch and kept into a different temperature to study the changes in developed cookies during interval of 0th to 3rd months.

Table 4-4: Storage Studies of developed Cookies at Ambient Temperature (25-27°C).

Sr no.	Parameter	0 th day	1 st month	2 nd month	3 rd month
1.	Moisture	14.2	14.33	14.38	14.44
2.	Ash	2.4	2.31	2.29	2.24

3.	Protein	13.62	13.59	13.55	13.51
4.	Fat	36.25	36.21	36.16	36.11

The moisture content of the cookies significantly increased from 14.2 per cent to 14.44 per cent. The increase in moisture content could be brought on by air permeability. Ash, fat and protein decreased to 2.4 per cent to 2.24 per cent, 36.25g to 36.11g/100g, and 13.62g to 13.51g/100g, respectively. Fat deterioration or the onset of rancidity may be to blame for the drop in fat content.

Table 5-5: Storage Studies of Developed Cookies at Refrigeration Temperature (4°C).

Sr no.	Parameter	0 th day	1 st month	2 nd month	3 rd month
1.	Moisture	14.2	14.23	14.26	14.27
2.	Ash	2.4	2.39	2.37	2.36
3.	Protein	13.62	13.60	13.58	13.56
4.	Fat	36.25	36.23	36.21	36.19

At refrigeration temperature, the rise in moisture from 14.2 per cent to 14.27 per cent. In addition, the amount of fat, protein, and ash per 100 grams fell from 36.25g to 36.19g, 13.62g to 13.56g, and 2.4 per cent to 2.36 per cent, respectively. Thus, it shows that refrigeration temperature is best storage temperature and it retain nutrients.

3.4 Microbial Analysis

The microbiological analysis results for the cookies, According to the microbiological assessment test results, the total plate count (TPC) was discovered to be 2500 cfu/g. Total plate count (TPC) was determined by aseptically inoculating 0.1 g of serially diluted samples in total plate count/ standard plate count agar medium prepared according to (Ranganna, 2009).

Table 6-6: Sensory Evaluation of Developed Cookies.

Sensory Evaluation	T0	T1	T2	T3	T4	T5
Appearance	8	8	7	7	8	8
Colour	8	7	7	7	8	5
Texture	7	7	8	7	8	7
Taste	6	6	7	7	9	8
Overall Acceptability	8	7	8	8	9	8

The result of the sensory analysis was based on the taste, texture, Color, appearance and overall acceptability presented in Table 6. It was showed, that cookies with only wheat flour (T0) had low rank for all the attributes indicating the preference was low. There was no significant difference among the T3 and T4 cookies with regard to the appearance, overall acceptability, taste and Color. Smooth and crunchy texture was observed by the panel list. The texture of the T₁ and T₂ sample was almost similar and was least preferred by the panel list. However, the T₃ sample showed significant difference in the terms of texture as compared to T₁ and T₂ sample. T₄ was the highest preferred sample with all the attributes approved and ranked by the panel list. The best and most liked cookies with the highest overall acceptability was T₄ with rating of 8.5.

3.6 Cost of Production

Table 7: Cost of production of Developed ecookies.

Ingredients	Rate / 100g	Quantity required (g)	Amount (₹)
Wheat	55	25 g	13.75
Sunflower	100	25 g	25
Pumpkin	150	50 g	75
Sugar	44	30 g	12
Butter	53	30 g	13.25
Additional charge	-	-	10
Processing charge	@ 10per cent of total cost	-	14.9
Total Cost = ₹ 163.9			

The price of each input was taken into account while calculating the cost associated with producing functional food products. The entire cost is increased by the processing fee and additional costs, such as depreciation. After accounting for 10 per cent of the processing costs, the sale price per 100 g of the items was computed. The cost of cookies that are significantly more enriched with sunflower and pumpkin seed flour than the control sample cookies. The designed cookies cost roughly ₹ 163.9 to produce 100 g. The higher cost is due to pumpkin seeds.

CONCLUSION

According to the findings presented in this study, created cookies were more nutritionally dense than regular wheat flour cookies. It was possible to establish that T₄ was the most recommended

formulation of sunflower seed, pumpkin seed, and wheat flour. The T₄ formulation of created cookies contains 14.2% moisture, 2.4% ash, 13.62% protein, 46.97% carbohydrates, 36.25% fat, 37.47 mg magnesium, 3.74 mg iron, 4.68 mg calcium, and provides up to 563.57 kcal/100 g energy. The contents in the produced cookies were carefully chosen to give ample energy, high protein, and minerals such as magnesium, calcium, iron, and zinc. During FT-IR we found that the peak in the absorbance wave number spectrum range vibration was observed 3301.74 cm⁻¹ which represent O-H group, 2927.81 cm⁻¹ and 2859.54 cm⁻¹ was observed which showed C-H group present in the cookies. During storage the moisture content of the cookies significantly increased from 14.2 to 14.44 per cent. Ash, fat and protein decreased to 2.4 to 2.24 per cent, 36.25 to 36.11 per cent and 13.62 to 13.51 per cent, respectively. At refrigeration temperature, the rise in moisture from 14.2 to 14.27 per cent. In addition, the amount of fat, protein, and ash fell from 36.25 to 36.19 per cent, 13.62 to 13.13.56 per cent, and 2.4 to 2.36 per cent, respectively. Thus, it shows that refrigeration temperature is best storage temperature and it retain nutrients. The cookies are safe to eat for both adults and children. The cookies might be an outstanding healthier alternative and the greatest replacement for unhealthy cookies.

REFERENCES

Akubor, P.I.2003. Functional properties and performance of cowpea/plantain/wheat flour blends in biscuits, *Plant Foods for Human Nutrition*, **58** :1-8.

Al-Khalifa, A.S.1996.Physicochemical characteristics, fatty acid composition, and lipoxygenase activity of crude pumpkin and melon seed oils, *Journal of Agricultural and Food Chemistry*, **44(4)** : 964-966.

Amin, M.Z., Islam, T., Uddin, M.R., Uddin, M.J., Rahman, M.M and Satter, M. A.2019. Comparative study on nutrient contents in the different parts of indigenous and hybrid varieties of pumpkin (*Cucurbita maxima* Linn.). *Heliyon*, **5(9)**.

Anjum, F.M., Nadeem, M., Khan, M.I and Hussain, S.2012. Nutritional and therapeutic potential of sunflower seeds: a review, *British Food Journal*, **114(4)**: 544–552.

AOAC, A.,2012. Official Method 948.22. Fat (crude) in Nuts and Nut Products. GravimetricMethods. Official Methods of Analysis of AOAC International, 19th edition.

Caili, F. U., Huan, S and Quanhong, L.I.2006. A review on pharmacological activities and utilization technologies of pumpkin, *Plant foods for human nutrition*, **61(2)**: 70-77.

Chowdhury, K., Banu, L.A., Khan, S and Latif, A.2007. Studies on the fatty acid composition of edible oil, *Bangladesh Journal of Scientific and Industrial Research*, **42(3)** : 311–316.

Formatted: Font: Italic

El-Adawy, T.A and Taha, K.M.2001. Characteristics and composition of different seed oils and flours, *Food chemistry*, **74(1)** : 47-54.

Fahim, A.T., Abd-El Fattah, A.A., Agha, A.M and Gad, M.1994. Effect of pumpkin-seed oil on the level of free radical scavengers induced during adjuvant-arthritis in rats, *Pharmacological research*, **31** : 73–79.

Hoover, W.1979. Use of soy proteins in baked foods, *Journal of the American Oil Chemists' Society*, **56(3)** : 301-303.

Kaya, Y. 2004. Sunflower breeding, seed industry and future directions in Turkey. In *Proceedings of 16th International Sunflower Conference, Fargo, North Dakota* pp. 465-472.

Koh, W. Y., Uthumporn, U., Rosma, A., Irfan, A.R and Park, Y.H.2018. Optimization of a fermented pumpkin-based beverage to improve *Lactobacillus mali* survival and α -glucosidase inhibitory activity: A response surface methodology approach, *Food Science and Human Wellness*, **7(1)** : 57-70.

Lazos, E.S.1992. Certain functional properties of defatted pumpkin seed flour, *Plant Foods for Human Nutrition*, **42**: 257-273.

Levin, I. W., & Bhargava, R.2005. Fourier transform infrared vibrational spectroscopic imaging: integrating microscopy and molecular recognition, *Annual Review of Physical Chemistry*, **56** : 429-474.

Formatted: Font: Italic

Maier, T., Schieber, A., Kammerer, D.R and Carle, R.2009. Residues of grape (*Vitis vinifera* L.) seed oil production as a valuable source of phenolic antioxidants, *Food Chemistry*, **112(3)** : 551–559.

Manley, D.1998. *Biscuit, Cookie and Cracker Manufacturing Manuals: Manual 1: Ingredients* (Vol. 1), Woodhead publishing.

Milovanovic, M and Vucelic-Radovic, B.2008. Sources, nutritional and health values of ω -3 and ω -6 fatty acids, *Journal of Agricultural Sciences (Belgrade)*, **53(3)** : 203-213.

Nyam, K.L., Lau, M and Tan, C.P.2013. Fibre from pumpkin (*Cucurbita pepo* L.) seeds and rinds: physico-chemical properties, antioxidant capacity and application as bakery product ingredients, *Malaysian Journal of Nutrition*, **19(1)**.

Patel, S.2013. Pumpkin (*Cucurbita* sp.) seeds as nutraceutical: a review on status quo and scopes, *Mediterranean Journal of Nutrition and Metabolism*, **6(3)**: 183-189.

Petibois, C and Deleris, G.2006. Chemical mapping of tumor progression by FT-IR imaging: towards molecular histopathology, *TRENDS in Biotechnology*, **24(10)** : 455-462.

Rajsekaran S, Sivagananan K and Subramaniam S.2005. Minerals contents of Aloe Vera leaf get and their role on streptocin-induced diabetic rats, *Biological Trace Element Research*, **108** : 185-95.

Ranganna, S.2009. Handbook of analysis and quality control for fruits and vegetables, Tata Mc. Graw Hill Publishing Company Limited. New Delhi-110, **7** : 9-10.

Revathy, M.N and Sabitha, N.2013.Development, quality evaluation and popularization of pumpkin seed flour incorporated bakery products, *International Journal of Food and Nutritional Sciences*, **2(2)** : 40.

Sharma, S. K., Khan, A. U., Khan, M., Gupta, M., Gehlot, A., Park, S and Alam, M.2020. Biosynthesis of MgO nanoparticles using Annona squamosa seeds and its catalytic activity and antibacterial screening, *Micro and Nano Letters*, **15(1)** : 30-34.

Stuart, B.H.2004. Infrared spectroscopy: fundamentals and applications, *John Wiley and Sons*.

Yadav, M., Jain, S., Tomar, R., Prasad, G.B.K.S and Yadav, H.2010. Medicinal and biological potential of pumpkin: an updated review, *Nutrition research reviews*, **23(2)**:- 184-190.

Yegorov, B., Turpurova, T., Sharabaeva, E and Bondar, Y.2019. Prospects of using by-products of sunflower oil production in the compound feed industry **13(1).pg**

UNDER PEER REVIEW