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Characterization of Lotus Seed Oil Based Functional Cookies for Growing Children

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ABSTRACT

Micronutrient deficiencies are very rare in children because of unhygienic eating pattern. Growth and development in toddlers are life-changing experiences that have significant impact on individual future as well as health of any future generation. The purpose of this study was to investigate the potential inversion of therapeutic advantages of lotus seed oil based cookies for the child's growth. The consumption of lotus seed oil cookies may prevent the abnormal growth of children. For this purpose seed oil based cookies was prepared for the child's growth and assess their proximate composition (Ash content, moisture, crude protein, crude fiber, fat). Ash content was recorded 1.3%. Moisture content, crude protein, crude fiber, and fat were recorded 1.68%, 8.32% 2.66% and 2.64% respectively. NFE was also recorded that is 76.2%.TPC was analyzed during the storage period of 30 days. It was observe that values decreases from 83.02 to 76.8 mg GAE/100g over one month of storage. TPC increased significantly from 409.12 to 399.0 mg GAE/100g over 30 days. DPPH values increased in T4 from 75.40 to 80.72 and decreased in T0 from 28.80 to 25.02. The sensory evaluation of cookies was also analyzed. Sensory parameters were assessed. Texture score generally increased in T3 and lowest in T1 and T2. Taste score varied across treatment with T4 scoring the highest and T1 was recorded lowest. Overall acceptability score declined with storage, with T0 initially scoring the highest followed by T2, indicating changes in sensory perception overtime.

INTRODUCTION

From infancy through puberty, a child's growth and development involve a number of complex changes. Physical development, cognitive malnutrition, emotional malnutrition, and social evolution are some of these changes (Shahzad et al., 2021). The development of motor skills, including walking and crawling, as well as fine motor skills, such as gripping and moving things, characterizes this stage (Norris et al., 2022). Each of these categories is critically dependent on nutrition, which affects children's overall health. A toddler's immune system is strengthened by good diet. Which reduce their susceptibility to infections and disease. Fortification is one of the most amazing interventions for meeting the children's nutritional needs (Lerner, 2021). The most crucial step is selecting an appropriate meal. Adolescence is a growth period is physiological system (Bégin et al., 2020). *Nelumbo nucifera* is also known as lotus seed, phool makhana or fox nut. It belongs to a small family of "Nelumbonaceae". It is a plant of the monogeneric family Nymphaeaceae, an aqueous annual herb in nature, that is symbol of beauty having an elegant fragrance (Dhull et al., 2022). It is an aquatic perennial flower. The genus is distributed over Northern Australia and North America, as well as the Asian continent (China, India and Russia). Lotus has been cultivated for its edible rhizomes, leaves and seeds in Asia for 7000 years (Chen et al., 2021). It is one of the China's most economic crops because of its nutritional value. China is producing 45000 million tons lotus seed and 9 million fresh rhizomes. Lotus has significant medical and commercial worth. There are several uses for nearly every component of the lotus. While the leaves and flowers are metabolized into medicinal medicines, lotus seeds and rhizomes have long been utilized as food items. There is a belief in traditional Chinese or Indian medicine that these four edible portions have therapeutic properties (Bangar et al., 2022). Lotus seed are rich in nutrients, but their content may exchange due to differences in cultivation, growing, and varieties (Zhang et al., 2023). Carbohydrates are plays several role in lotus seed. By consuming complex carbohydrates, such as those in lotus seeds, children's learning and cognitive development are supported by a steady supply of glucose. The protein content in lotus seed is approximately 15-18 grams per 100 grams of dried lotus seed. The protein in lotus seed provide the essential amino acids needed to maintain their growth. As the structural protein that supports bones, tendons, and cartilage, collagen is produced mostly by proteins. Healthy bone formation is supported by an adequate protein diet, which can be obtained from lotus seed (Zhang et al., 2015). Lotus seeds are particularly rich in minerals, including phosphorus, calcium, magnesium, iron and many other macronutrients, in addition to macronutrients and vitamins (Awal et al., 2020). From infancy through puberty, a child's growth and development involve a number of complex changes. Physical development, cognitive malnutrition, emotional malnutrition, and social evolution are some of these changes. Each of these categories is critically dependent on nutrition, which affects children's overall health (Khushboo & Singh, 2020). Lotus seed essential oil is help to improve the children bone health. Zinc is essential for cellular growth and immunological to functions, and plays a role in DNA. Frequently eating of food high in zinc, such as lotus seed, allows adolescents to grow to their maximum potential and encourage regular growth patterns. High level of zinc consumption are linked to improved cognitive functions, including learning, and memory. Magnesium is necessary for the muscle and nerve function.It is necessary for the structural growth of bone matrix and aids in the regulation of calcium level. The neurological system's carrier molecules, or transmitters, are regulated by magnesium present in lotus seed. It also promotes the growth of the brain and preserves neuronal function. Iron help oxygen transfer in the blood. On average, lotus seed provide approximately 1.4 to 1.7 milligrams of iron per 100 grams. Both the synthesis of neurotransmitter and cognitive development are influenced by iron (Salgueiro et al., 2002). The lotus seed oil contains calcium which is necessary for the development and, maintenance of strong bones and teeth. It contributes the growth of bone mass, which is necessary for healthy skeletal development during the formative years. Enough calcium must also be consumed in order for the heart, muscles, and neurons to function properly (Chouaibi et al., 2012). Several B vitamins such as B1, B2 and B6 are abundant in lotus seed. Thiamine which is necessary for the metabolism of carbohydrates helps growing children meet their energy needs (Saeed et al., 2020). Lotus seed oil contains omega 3 fatty acid, which is vital for the brain development (Zaidi et al., 2021).Since cookies are a popular snack, using lotus seed oil as a main component in cookies is an inventive and efficient approach to provide kids these health advantages. A cookie's decadent qualities must be balanced with the nutritional integrity needed for a developing youngster (Pan et al., 2016). In contrast to traditional cookies, which are frequently heavy in bad fats and chemical additives, lotus seed oil-based cookies may be prepared using healthy, kid-friendly ingredients like almond flour, oats, whole wheat flour, and natural sweeteners like honey or dates (Talabi et al., 2019).

MATERIALS AND METHODOLOGY

The current study will be carried out Department of Human Nutrition and Dietetics, at the Riphah International University Faisalabad, Pakistan. The work includes developing cookies made primarily lotus seed oil. Lotus seed powder will be purchased from local market. Other raw material required for the preparation of cookies also purchased from local market of city.

The lotus seeds were finely ground using an electronic grinder until a smooth, uniform powder was achieved. A measured amount of this powder was placed in a filter paper thimble for oil extraction. The solvent was heated in a flask, allowing it to evaporate, condense, and cycle through the Soxhlet apparatus to extract the oil from the seeds. After extraction, the solvent–oil mixture was separated using a rotary evaporator to obtain pure lotus seed oil. The extracted oil was then stored in a dark container to protect it from oxidation (Ahangari et al., 2021).

Table 1

Treatment Plans

Treatment	Shortening(SHO) %	Lotus seed oil(LSO) %
T_0	100	-
T_1	95	5
T_2	90	10
T_3	85	15
T_4	80	20

Cookies were prepared according to the AACC (2016) standard method, using different amounts of lotus seed oil. Four batches were made: one control batch with only shortening, and three others where 10%, 15%, and 20% of the shortening was replaced with lotus seed oil. The dough was made by mixing flour, oil, yeast, milk, salt, sugar, and water. It was kneaded, rolled to an even 8 mm thickness, and cut into round shapes using a scone cutter. The cookies were baked at 160°C for 15 minutes, then cooled at room temperature (28°C) and packed in polythene bags for storage.

The lotus seed powder were analyzed including ash, moisture content, crude fiber, crude fat, and NFE content were performed by the method of (Mgbemena et al., 2019).

The total phenolic content of lotus seed extract were used by the method described by (Hossain et al., 2011). The amount of total phenols in the crude extracts was quantified using the Folin-Ciocalteu reagent and externally calibrated with Gallic acid. Simply 0.2 mL of extracted solution and 0.2 mL of Folin-Ciocalteu reagent were incorporated and carefully stirred. After 4 min, 1 mL of 15% Na_2CO_3 was added, and then the mixture was allowed to stand for 2 h at normal temperature. The absorbance was measured at 760 nm using a Spectra (Thermo Fisher Scientific, model 4001/4) spectrophotometer.

The DPPH radical scavenging ability will determined by the method of (Benyoucef *et al.*, 2018). Each test tube 3 milliliters of freshly dissolved 1 milligram DPPH mixed in 100 milliliters of methanol after the sample extract (0.0256 milliliters) were combined with 10 milliliters of ethanol. The sample that was ready was left in the dark for fifteen minutes. The UV visible spectrophotometer was used to quantify the absorbance at 517nm. The very stable and oxidizing radical DPPH create a yellow-colored hydrazine throughout the entire process, which is also connected to the elimination of free radicals with the hydrogen atom of phenolic molecule.

According to the methodology described by Hooda and Jood (2005) the baked cookies with various formulations was submitted to sensory assessment using the Hedonic Scale at various storage intervals.

A data was collected and analyzed, with the result subjected to statistical analysis utilizing randomized design CRD for further examination in compliance with the (Montgomery et al., 2018).

RESULTS AND DISCUSSION

From infancy through puberty, a child's growth and development involve a number of complex changes. Physical development, cognitive malnutrition, emotional malnutrition, and social evolution are some of these changes. Each of the life stage is critically dependent on nutrition, which affects children's overall health. Lotus seed oil based cookies are high in fiber, protein, and omega-3 fatty acids, minerals and low in calories and sugar. They offer several potential health benefits for children growth and development management, including improved motor skills, immune system, reduced inflammation, and enhanced antioxidant defenses. Additionally, they are cost-effective and made with affordable ingredients, making them a practical option for those who are stunted growth.

Table 2

Compositional Analysis of LSO ± S.D

Parameters	Lotus Seed Oil
Moisture	1.68 ± 0.03
Ash	1.3 ± 0.69
Crude Protein	8.32 ± 0.23
Crude Fiber	2.66 ± 0.02
Fat	2.64 ± 0.05
NFE	76.2 ± 0.05

The percentage of moisture content of lotus seed was analyzed 1.68 ± 0.03.The moisture content in lotus seed comparable with the study of Bangar et al. (2022) reported the moisture content (2.08 ± 0.7%). Chinelo and Jega (2019) conducted the study on nutritional composition on lotus seed and its evaluation reported that the moisture content in lotus seed is (1.75 ± 0.2%).

The ash content of lotus seed was analyzed and recorded 1.3 ± 0.69. Baehaki et al. (2021)conducted the study on lotus seed as a healthy promoting compound and findings states the ash content in lotus seed is (1.45± 0.56%). Awal et al. (2020) conducted the study on the bioactive compound and healthy effects of lotus seed reported that ash content of lotus seed is (1.29 ± 0.77%). Singh (2021) shows the nutritional finding shows the ash content of lotus seed is (1.4 ± 0.4%).

The protein content of lotus seed was analyzed 8.32 ± 0.23. Shahzad et al. (2021) research the nutritional aspects of some plants including lotus seed and finding states the protein content in lotus seed is (8.48 ± 0.25%) that makes the highly efficient in there working. Bangar et al. (2022) determined the protein quality of lotus seed and finding states the protein content in lotus seed is (8.02 ± 0.32%).

The fiber content of lotus seed is 2.66 ± 0.02. Awal et al. (2020) did study on lotus seed and finding include that the content of crude fiber in lotus seed (2.82 ± 0.03%). Laminu et al. (2021) conducted the study on physicochemical properties and antioxidant activity of lotus seed in crude fiber (2.62 ± 0.04%) was reported. The value of crude fiber according to the study Sathithon and Yan-bin (2012) was recorded (2.97 ± 0.06%).

The fat content of lotus seed was recorded as 2.64 ± 0.05. Zhang et al. (2015) analyzed the proximate composition of various genotype of lotus seed from same ecological condition analyzed crude fat is (3.0 ± 0.04%). Musa et al. (2012) conducted the study on physicochemical and biochemical properties of native and hybrid varieties of lotus seed crude fat (2.56 ± 0,10%) who evaluated. Shahzad et al. (2021) analyzed the chemical composition of lotus seed of crude fat is (2.71 ± 0.07%) was reported.

The nitrogen free extract of lotus seed were 76.2 ± 0.05%. The results show that lotus seed high amount of carbohydrates and other nitrogen free compound.

Table 3

Effects of Storage and Treatment on TPC±S.D (mg GAE/100g) of (LOS) Based Cookies

Treatment	Storage days			Means
	0	15	30	
T_0	80.22±4.15	79.21±3.15	77.12±3.15	77.85±3.15
T_1	103.67±3.45	99.67±2.99	97.43±2.99	100.2±3.15
T_2	238.29±2.16	210.12±1.99	206.32±2.16	218.24±2.16
T_3	409.12±1.42	399.01±1.21	397±1.42	401.71±1.42
T_4	608±5.5	593.13±4.5	590.2±5.5	597.1±5.5
Over all mean	287.86±3.33	276.22±2.78	273.614±2.78	

Following a 30-day storage period, the total phenolic content of cookies made from lotus seed oil was measured and recoded. For T0, T1, T2, T3, T4, and T5, the comparison revealed mean values of 80.22±4.15, 103.67±3.45, 238.29.50±3.45, 238.29±2.29, 409.12±1.42, and 608±5.5 respectively. The T0 value decreased from 83.02 to 76.8 mgGAE/100g throughout a 30-day storage period. About 103.67 mgGAE/100g over various storage periods. The T1 value in TPC decreased throughout 30 days of storage from 103.76 to 79.21 mgGAE/100g. Intervention T2 drop in TPC during 30 days of storage from 238.29 to 210.12 mgGAE/100g. In TPC, the value of treatment T3 increased from 409.12 to 399.01 mgGAE/100g throughout a 30-day storage period. Intervention over 30 days of storage, T4 decreases in TPC from 608 to 593.13 mgGAE/100g. Results from treatments T3 and T4 are also encouraging. Kaur et al. (2019) showed that refined wheat flour had 6.23% protein and 0.05% fiber, which rose to around 8.20% and 2.37%, respectively, after adding raw lotus seed flour in 80:20 ratios.According to Zlatanovic et al. (2019) they retained well-known health-promoting components and preserved a crisp texture and highly fruity scent. The published values for beetroot poace (up to 3.8 mgGAE/gdryweight) and apple poace (1.1 mgGAE/g dryweight) are lower than these. Comparing DSSF to wheat flour, the TPC findings showed that it has a better antioxidant capacity as determined by the DPPH and CUPRAC tests. Ghosal et al. (2022) when compared to other digestible products, the phenolic content (24.41 ± 0.17 mgGAE/g), total flavonoid content (18.34 ± 0.03 mgCE/g), and antioxidant activities of the raw deoiled flaxseed protein hydrolysates spread were likewise noticeably greater.

Table 4

Effects of Storage and Treatment on DPPH ± S.D of (LOS)BasedCookies

Treatment	Storage days			Mean
	0	15	30	
T_0	28.80±0.70	27.80±0.6	26.4±0.6	27.6±0.6
T_1	37.7±0.51	35.14±0.4	33.12±0.4	35.32±0.4
T_2	41.21±0.9	39.21±0.8	37.19±0.9	39.20±0.9
T_3	57.14±0.4	54.12±0.3	53.07±0.3	54.7±0.3
T_4	75.40±0.21	73.40±0.2	72.4±0.2	73.73±0.2
Over all mean	48.05±0.54	46.04±0.46	44.436±0.46	

The findings of the study on the DPPH of cookies made with seeds were recoded after 30 days of storage. Both treatment and storage length have an impact on the DPPH of cookies made with seeds (PSSF). Comparing T0, T1, T2, T3, T4, and T5, the results were as follows: 28.80±0.70, 37.7±0.51, 41.21±0.9, 57.14±0.4, and 75.40±0.21 respectively. In comparison to other treatments, treatment T4 continuously shows an increase in DPPH values during all storage times. Treatment T4 exhibits a minor rise in DPPH. Over the course of storage, the mean DPPH values typically show a declining trend, with treatments T2, T3, and T4 continuing to exhibit more antioxidant activity than T0 and T1. Another study by Bialek et al. (2015) found that lotus seed oil antioxidant capacity, as determined by DPPH reduction, was high (64%) and consistent with the findings. Our experiment's lotus seed oil had a far greater DPPH radical scavenging activity than previously reported. Agurla, (2023) analyzed the chia seed oil had a DPPH radical scavenging activity of 39.5% at a 12 mg/mL concentration. It is reasonable to expect that the incorporation of chia seed oil into cookies would result in an increase in the antioxidant activity of the final product.

Table 5

Effects of storage and treatment on texture ± S.D of (LOS) Based Cookies

Treatment	Storage days			Means
	0	15	30	
T_0	7.00±0.18	6.94±0.17	6.93±0.17	6.95±0.17
T_1	6.96±0.15	6.56±0.14	6.56±0.14	6.69±0.14
T_2	6.93±0.08	6.35±0.07	6.35±0.07	6.54±0.07
T_3	7.05±0.07	7.00±0.06	7±0.06	7.01±0.06
T_4	7.04±0.09	6.99±0.09	6.99±0.09	7.0±0.09
Over all mean	6.99±0.11	6.768±0.10	6.766±0.10	

The sensory assessment data were examined after 30 days of storage. Analysis revealed that texture displayed treatment and storage outcomes that were not statistically significant. 7.0±0.1, 6.96±0.7, 6.93±0.8, 7.05± 0.7 and 7.04± 0.9are the texture scores for T0, T1, T2, T3, T4, and T5. Cookies based on texture of seed (LSO) were stored for 30 days instead of 0 days. Treatment T3 has the highest texture score (7.05±0.7), followed by T1 (6.93±0.8), and T2 (6.93±0.8) has the lowest score. The findings of this investigation align with other studies that demonstrated that the kind of flour used influences cookie texture (Kumar et al., 2011). The results of this investigation also underscore the need of taking into account the textural characteristics of cookies while creating new goods. When Okpala, Okoli, and Udensi (2013) examined the sensory qualities of cookies with at least 50% GPF, they found that texture, flavor, crispness, and overall acceptability all had poor scores (<7), with the exception of 17.7CF:17.7FSF:68.6GPF. The sensory analysis's findings demonstrated that the texture information for the cookies from 100GPF agreed well with the measurement obtained from the fragility tests. Cookies with high GPF levels, according to panelists, lack the distinctive crispness and texture of cookies and have a bitter aftertaste. It follows that despite the high protein content of GPF-containing cookies, many people would not want to consume them. Every cookie was at least marginally preferred for the characteristics under study, with the exception of those formulations with more than 50% GPF.

Table 6

Effects of storage and treatment on taste ± S.D of (LOS) Based Cookies

Treatment	Storage days			Mean
	0	15	30	
T_0	6.3±0.2	6.2±0.1	6.1±0.1	6.2±0.1
T_1	6.2±0.3	6.1±0.2	6.1±0.2	6.1±0.2
T_2	6.6±0.4	6.5±0.3	6.5±0.3	6.5±0.3
T_3	6.4±0.6	6.3±0.5	6.3±0.5	6.3±0.5
T_4	6.9±0.5	6.8±0.4	6.7±0.5	6.7±0.5
Over all mean	6.48±0.4	6.38±0.3	6.34±0.5	

The findings from the sensory assessment of the therapy were examined after 30 days of storage.Taste analysis revealed that storage had no discernible effect while treatment had a substantial effect. T0, T1, T2, T3, T4, and T5 received respectability scores of 6.3±0.2, 6.2±0.3, 6.6±0.4, 6.4±0.4, and 6.9±0.5. Taste of seed oil (LSO) based cookies was decreased from 0 to 30 days for storage period. In treatment T4 has maximum taste score (6.9±0.5) and minimum score in T1 (6.2±0.3). According to a sensory study conducted by Palamthodi, Shimpi, and Tungare (2021), adding up to 20% jackfruit seed flour to wheat considerably ($p < 0.05$) improved the biscuits' flavor. Increased jackfruit seed flour content made the biscuits taste harsh. In their analysis of the sensory qualities of cookies having at least 50% GPF, Okpala, Okoli, and Udensi (2013) found that all but 16.7CF:16.7FSF:66.6GPF had low taste ratings (< 6). The measurement obtained from the fragility tests and the taste data for cookies from 100GPF agreed well. Cookies with high GPF levels, according to panelists, lack the distinctive crispness and flavor of cookies and have a bitter aftertaste. This suggests that despite the high protein content of GPF-containing cookies, many people would not be inclined to consume them due to their poor sensory quality.

Table 7

Effects of storage and treatment on Overall acceptability ± S.D of (LOS) Based Cookies

Treatment	Storage days			Means
	0	15	30	
T_0	8.2±0.3	8.1±0.2	8±0.2	8.1±0.2
T_1	7.8±0.5	7.7±0.4	7.7±0.4	7.7±0.4
T_2	7.4±0.6	7.3±0.5	7.3±0.5	7.3±0.4
T_3	7.7±0.4	7.6±0.3	7.6±0.3	7.6±0.3
T_4	7.7±0.9	8.2±0.8	8.2±0.8	8.0±0.8
Over all mean	7.88±0.5	7.78±0.4	7.76±0.4	

The sensory assessment data were examined after 30 days of storage. The respectability scores for T0, T1, T2, T3, T4, and T5 are 8.2±0.3, 7.8±0.5, 7.4±0.6, 7.7±0.4 and 7.7±0.9

respectively. Overall cookie acceptability based on seed oil (LSO) was reduced from 0 to 30 days of storage. Treatment T2 had the lowest appearance score (7.4±0.6) and the highest overall acceptability score (8.2±0.3). The sensory analysis results from Goyatetal (2018) showed that the replacement cookie samples were generally acceptable, scoring higher than six on a nine-point hedonic scale. The best replaced samples were determined to be C-15% and Q-20% based on the 64 sensory and nutritional characteristics that were found. Without experiencing a noticeable change in texture, both cookies may be kept for 60 days at room temperature in sealed polypropylene bags. The sensory assessment of cookies made with lotus seed oil (Bari 2011) at concentrations of 10% (FC1), 20% (FC2), 25% (FC3), 15% (FC4), and 5% (FC5), as well as a control (FC0), was examined by Bilal et al. (2020).The 60-day storage research evaluated the goods' quality, sensory assessment, and oxidative stability in the following order: FC3 > FC4 > FC5 > FC1 > FC2 > FC0. The cookies made with a 15% substitution of peanut oil generated a product that was satisfactory.

CONCLUSION

The investigation of the child's growth and development organization of Lotus seed oil (LSO) based cookies has revealed promising insight. These substances have been shown to have substantial health advantages via thorough investigation and analysis, especially in the treatment of child's abnormal growth symptoms including stunted growth and slow physical development. Infants with abnormal growth and weak immune system may easily and enjoyably incorporate these healthy elements into their diets In connection with the development of these cookies. Additionally, the cookies' nutrient-rich composition offers a healthful choice for enhancing general wellbeing. All things considered, the results highlight the cookies' potential as a dietary intervention for child's growth and development, pointing to directions for future study and their integration into dietary management plans for the illness.

REFERENCES

Ahangari, H., King, J. W., Ehsani, A., & Yousefi, M. (2021). Supercritical fluid extraction of seed oils – A short review of current trends. *Trends in Food Science & Technology*, *111*, 249-260. https://doi.org/10.1016/j.tifs.2021.02.066

Awal, M. R., Rahmatullah, S., & Nasrin, S. (2020). Nutrient composition of lotus (Nelumbo nucifera) fruits. *Asian-Australasian Journal of Bioscience and Biotechnology*, *5*(3), 115-120. https://doi.org/10.3329/aajbb.v5i3.53873

Baehaki, A., Rinto R, R., Hendri, M., Sudirman, S., & Buana, J. P. (2020). Proximate composition and antioxidant activities of vegetable milk from lotus seeds (Nolumbo nucifera). *Pharmacognosy Journal*, *13*(2), 427-433. https://doi.org/10.5530/pj.2021.13.54

Bangar, S. P., Dunno, K., Kumar, M., Mostafa, H., & Maqsood, S. (2022). A comprehensive review on lotus seeds (Nelumbo nucifera Gaertn.): Nutritional composition, health-related bioactive properties, and industrial applications. *Journal of Functional Foods*, *89*, 104937. https://doi.org/10.1016/j.jff.2022.104937

Bari, A., Mar, A. C., Theobald, D. E., Elands, S. A., Oganya, K. C., Eagle, D. M., & Robbins, T. W. (2011). Prefrontal and Monoaminergic contributions to stop-signal task performance in rats. *Journal of Neuroscience*, *31*(25), 9254-9263. https://doi.org/10.1523/jneurosci.1543-11.2011

Bégin, F., Elder, L., Griffiths, M., Holschneider, S., Piwoz, E., Ruel-Bergeron, J., & Shekar, M. (2020). Promoting child growth and development in the sustainable development goals era: Is it time for new thinking? *The Journal of Nutrition*, *150*(2), 192-194. https://doi.org/10.1093/jn/nxz244

Benyoucef, F., Dib, M. E., Arrar, Z., Costa, J., & Muselli, A. (2018). Synergistic antioxidant activity and chemical composition of essential oils from thymus fontanesii, artemisia herba-alba and Rosmarinus officinalis. *Journal of Applied Biotechnology Reports*, *5*(4), 151-156. https://doi.org/10.29252/jabr.05.04.03

Chen, C., Li, G., & Zhu, F. (2021). A novel starch from lotus (Nelumbo nucifera) seeds: Composition, structure, properties and modifications. *Food Hydrocolloids*, *120*, 106899. https://doi.org/10.1016/j.foodhyd.2021.106899

Chinelo, A. S., & Jega, U. K. (2019). Proximate and amino acid analyses of the rhizome of <i>Nymphaea lotus</i> (Water lily). *Modern Chemistry*, *7*(3), 54. https://doi.org/10.11648/j.mc.20190703.12

Chouaibi, M., Mahfoudhi, N., Rezig, L., Donsì, F., Ferrari, G., & Hamdi, S. (2011). Nutritional composition of *Zizyphus lotus* L. seeds. *Journal of the Science of Food and Agriculture*, *92*(6), 1171-1177. https://doi.org/10.1002/jsfa.4659

Dhull, S. B., Chandak, A., Collins, M. N., Bangar, S. P., Chawla, P., & Singh, A. (2022). Lotus seed starch: A novel functional ingredient with promising properties and applications in food—A review. *Starch - Stärke*, *74*(9-10). https://doi.org/10.1002/star.202200064

Ghosal, K., & Nayak, C. (2022). Recent advances in chemical recycling of polyethylene terephthalate waste into value added products for sustainable coating solutions – hope*vs.* hype. *Materials Advances*, *3*(4), 1974-1992. https://doi.org/10.1039/d1ma01112j

Hooda, S., & Jood, S. (2005). Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour. *Food Chemistry*, *90*(3), 427-435. https://doi.org/10.1016/j.foodchem.2004.05.006

Hossain, M. A., Shah, M. D., Gnanaraj, C., & Iqbal, M. (2011). In vitro total phenolics, flavonoids contents and antioxidant activity of essential oil, various organic extracts from the leaves of tropical medicinal plant Tetrastigma from Sabah. *Asian Pacific Journal of Tropical Medicine*, *4*(9), 717-721. https://doi.org/10.1016/s1995-7645(11)60180-6

Kaur, P., Kaur, L., Kaur, N., Singh, A., Kaur, J., Kaur, H., ... & Kaur, M. (2019). A brief review on pharmaceutical uses of Nelumbo nucifera. *Journal of Pharmacognosy and Phytochemistry*, *8*(3), 3966-3972.

Khushboo, T., & Singh, D. (2020). Fortification of cookies using Nelumbo nucifera rhizome (Lotus stem) to meet the nutritional requirement of toddlers. *International Journal of Food Science and Nutrition*, *5*(3), 44-49.

Kumar, S. V., Kumar, S. P., Dudhe Rupesh, D. R., & Kumar Nitin, K. N. (2011). Immunomodulatory effects of some traditional medicinal plants, 675-684. http://jocpr.com/vol3-iss1-2011/JCPR-3-1-675-684.pdf

Laminu, H. H., Sa'ad, R. S., Damasak, A. A., Abubakar, M. I., Bala, A. M., Madu, D. K., & Theresa, C. I. (2021). Nutritional value of green and red Nymphaea lotus seeds and their glycemic index. *IOSR Journal of Biotechnology and Biochemistry*, *7*(4), 25-33.

Lerner, R. M. (2021). Children and adolescents as producers of their own development. In *Individuals as Producers of Their Own Development* (pp. 75-102). Routledge.

Mgbemena, N. M., Ilechukwu, I., Okwunodolu, F. U., Chukwurah, J. O., & Lucky, I. B. (2019). Chemical composition, proximate and phytochemical analysis of and peels, seed coat, leaves and seeds. *Ovidius University Annals of Chemistry*, *30*(1), 65-69. https://doi.org/10.2478/auoc-2019-0012

Montgomery, D. W., Amira, A., & Zaidi, H. (2007). Fully automated segmentation of oncological PET volumes using a combined multiscale and statistical model. *Medical Physics*, *34*(2), 722-736. https://doi.org/10.1118/1.2432404

Musa, A., Birnin-Yauri, U. A., Muhammad, C., & Umar, A. (2012). Proximate composition and mineral analysis of Nymphaea lotus seeds. *African Journal of Food Science and Technology*, *3*(7), 1-5.

Norris, S. A., Frongillo, E. A., Black, M. M., Dong, Y., Fall, C., Lampl, M., Liese, A. D., Naguib, M., Prentice, A., Rochat, T., Stephensen, C. B., Tinago, C. B., Ward, K. A., Wrottesley, S. V., & Patton, G. C. (2022). Nutrition in adolescent growth and development. *The Lancet*, *399*(10320), 172-184. https://doi.org/10.1016/s0140-6736(21)01590-7

Okpala, L., Okoli, E., & Udensi, E. (2012). Physico-chemical and sensory properties of cookies made from blends of germinated pigeon pea, fermented sorghum, and cocoyam flours. *Food Science & Nutrition*, *1*(1), 8-14. https://doi.org/10.1002/fsn3.2

Pan, A., Zeng, H., Alain, G. B., & Feng, B. (2016). Heat-pretreatment and enzymolysis behavior of the lotus seed protein. *Food Chemistry*, *201*, 230-236. https://doi.org/10.1016/j.foodchem.2016.01.069

Palamthodi, S., Shimpi, S., & Tungare, K. (2021). A study on nutritional composition and functional properties of wheat, ragi and Jackfruit seed composite flour. *Food Science and Applied Biotechnology*, *4*(1), 63. https://doi.org/10.30721/fsab2021.v4.i1.107

Saeed, S. M., Tayyaba, S., Ali, S. A., Tayyab, S., Sayeed, S. A., Ali, R., Mobin, L., & Naz, S. (2020). Evaluation of the potential of lotus root *(Nelumbo nucifera)* flour as a fat mimetic in biscuits with improved functional and nutritional properties. *CyTA - Journal of Food*, *18*(1), 624-634. https://doi.org/10.1080/19476337.2020.1812727

Salgueiro, M. J., Zubillaga, M. B., Lysionek, A. E., Caro, R. A., Weill, R., & Boccio, J. R. (2002). The role of zinc in the growth and development of children. *Nutrition*, *18*(6), 510-519. https://doi.org/10.1016/s0899-9007(01)00812-7

Sheikh, S. A. (2014). Ethno-medicinal uses and pharmacological activities of lotus (Nelumbo nucifera). *J. Med. Plants Stud*, *2*(6), 42-46.

Sathithon, P. (2012). Effect of sprouting on the chemical and nutritional qualities and phenolic alkaloid content of lotus (Nelumbo nucifera Gaertn.) seeds. *African Journal of Food Science*, *6*(7). https://doi.org/10.5897/ajfs12.032

Shahzad, M. A., Ahmad, N., Ismail, T., Manzoor, M. F., Ismail, A., Ahmed, N., & Akhtar, S. (2020). Nutritional composition and quality characterization of lotus (Nelumbo nucifera Gaertn.) seed flour supplemented cookies. *Journal of Food Measurement and Characterization*, *15*(1), 181-188. https://doi.org/10.1007/s11694-020-00622-x

Singh, S. (2021). Structure and Properties of Lotus Seed Flour and Starch. In *Handbook of cereals, pulses, roots, and tubers* (pp. 583-596). CRC Press.

Talabi, J. Y., Origbemisoye, B. A., Ifesan, B. O., & Enujuigha, V. N. (2019). Quality characterization of biscuits from blends of Bambara groundnut (Vigna subterranea), ground bean seed (Macrotyloma) and moringa seed (Moringa oleifera) flour. *Asian Food Science Journal*, 1-12. https://doi.org/10.9734/afsj/2019/v12i430092

Zaidi, A., & Srivastava, A. K. (2019). Nutritionaland therapeutic importance of nelumbo nucifera (Sacred lotus). *Era's Journal of Medical Research*, *6*(2), 98-102. https://doi.org/10.24041/ejmr2019.138

Zhang, Y., Lu, X., Zeng, S., Huang, X., Guo, Z., Zheng, Y., Tian, Y., & Zheng, B. (2015). Nutritional composition, physiological functions and processing of lotus (Nelumbo nucifera Gaertn.) seeds: A review. *Phytochemistry Reviews*, *14*(3), 321-334. https://doi.org/10.1007/s11101-015-9401-9

Zhang, Y., Xu, Y., Wang, Q., Zhang, J., Dai, X., Miao, S., & Lu, X. (2023). The antioxidant capacity and nutrient composition characteristics of lotus (Nelumbo nucifera Gaertn.) seed juice and their relationship with color at different storage temperatures. *Food Chemistry: X*, *18*, 100669. https://doi.org/10.1016/j.fochx.2023.100669

Zlatanović, S., Kalušević, A., Micić, D., Laličić-Petronijević, J., Tomić, N., Ostojić, S., & Gorjanović, S. (2019). Functionality and Storability of cookies fortified at the industrial scale with up to 75% of Apple pomace flour produced by dehydration. *Foods*, *8*(11), 561. https://doi.org/10.3390/foods8110561