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A Potential Strategy to Improve the Nutritional Status of Consumers: The Nutritional Value of Pasta Fortified with Super Seeds

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Abstract: Seeds are highly nutritious food. They are small in size but are rich in various beneficial nutrients like complex carbs, healthy fats, plant-based proteins, dietary fiber, vitamins, minerals, phenols and flavonoids. Seeds also possess antioxidants, and anti-inflammatory properties which help in the prevention of many diseases. Pasta can be supplemented with a variety of super seed powders to boost nutritional content, functioning, or to make up for nutritional deficits. In present study pasta had been enriched with powder of 5 super seeds, including Chia seeds, pumpkin seeds, muskmelon seeds, poppy seeds, and flax seeds which had been used in replacement of white flour. Pasta was intended for people of all ages, with a focus on those with co-morbidities such as cardiovascular disease, lung illness, constipation, obesity, hypertension, bone disorders, diabetes, ulcers, and cancer. The proximate analysis of pasta and super seeds for moisture content, ash content, crude fat, crude protein, and fiber has been analyzed through suitable statistical tool. Moisture content of seed was 4.5±0.20 while pasta moisture

content was 30±0.2, ash content of seeds was 4.8±0.1 while pasta ash content was 42.6±0.28, crude fat content of seeds was 37±0.1 while pasta fat content was 13.95±0.07 in proximate analysis Conclusion leads that super seed powder is nutritionally very beneficial and rich in protein, fiber, antioxidants and helps to overcome with many health issues.

Keywords: Super Seeds, Enriched Pasta, Pumpkin Seed, Muskmelon Seed, Flax Seeds, Chia Seeds, Poppy Seeds, Proximate analysis

Introduction: Nutrition is the study of food and how it interacts with and affects the human body. Cells, their components, and organisms all require nutrition to live. It is the proper provisioning of substances such as minerals, fibre, vitamins, water, and other essential dietary components. Many common health problems can be avoided or alleviated by eating well. Diet refers to the quantity or number of foods consumed by humans on a daily basis that have a significant influence on their health (Eastwood, M. A. 2013). Seeds are a good source of plant protein, fibre, vitamins, minerals, beneficial fatty acids, phenols, sterols, phytoestrogens, anti-inflammatory agents, and antioxidants, all of which assist to lower blood pressure, cholesterol, and regulate blood sugar, inflammation, bone, and lung problems (Chicco et al., 2008).

Food fortification is a method endorsed by the World Health Organisation and the United Nations Food and Agriculture Organisation, which involves the addition of micronutrients to food products. The primary objective of this technique is to enhance the nutritional value of food, hence yielding public health advantages and mitigating potential risks (Tamargo et al., 2020). The technique of incorporating micronutrients into processed meals is commonly referred to as food fortification. In some instances, this methodology has the potential to provide substantial enhancements in the micronutrient status of a population, while incurring minimal expenses, particularly if pre-existing era and community distribution networks can be utilised to their advantage. The implementation of meal fortification as a public health intervention has the potential to yield significant benefits, making it a cost-effective approach (Alfawaz, M. A. 2004).

Pasta is enriched with 5 super seeds such as Chia seeds, pumpkin seeds, muskmelon seeds, poppy seeds, and flax seeds. It is designed for people of all ages, with a focus on those with co-morbidities such as cardiovascular disease, lung illness, obesity, hypertension, bone abnormalities, and diabetes (Madhusudhan, 2009).

The composition of flax seed has a group of vitamins like vitamin A, B, D and E and some nutritive amount of minerals also like potassium. Flax seed contain a dense amount of potassium than banana. It contains a very good

amount of amino acid compared to the richest source of amino acid soya beans, the most nutritive vegetable protein. Flax seed contain linolenic acid, part of fatty acid family and phytoestrogen lignans, and contain an abundant amount of dietary fiber as well (Lestari B and Meiyanto, E. 2018).

Chia (Salvia hispanica L.) is a hygroscopic annual herbaceous plant with small oval shaped seeds with a glossy speckled seed coat with a crunchy texture and a moderate nutty flavor that ranges in color from dark brown to gray-white. Chia seeds are a high-fiber food that aids weight loss, improves lipid profiles, lowers blood sugar levels, and lowers blood pressure. These fibres improve cardiovascular health by raising HDL levels and lowering LDL levels, delaying stomach emptying and enhancing the production of intestinal hormones that promote satiety and weight loss (Bernacchia et al., 2014)

Pumpkin seeds include high level of Magnesium, iron, Zinc, Phosphorus, potassium, Selenium, Manganese and Copper. Examination of 'Lady Godiva' variety showed that < 400 g of pumpkin seeds can supply the entire daily protein and mineral requirements other than Calcium and sodium for a mature person. Pumpkin seed oil has high quantity of free fatty acids content with major being palmitic, stearic, oleic and linoleic acids (Hall III et al., 2005).

The papaveraceous family includes poppy seeds (L. Papaver somniferum). The seeds are tiny bean-shaped and range in color from greyish blue to dark blue. They have a faint nut aroma and a subtle nut flavor. The abundance of polyunsaturated fatty acids in this plant's seed is its most notable trait. Poppy seeds include physiologically active chemicals like flavonoids, phenols, sterols, and antioxidants that have antioxidant, antibacterial, and anti-inflammatory activities and can be utilized to treat infectious disease (De Falco et al., 2017)

The Cucurbitaceae family includes muskmelon seeds (Cucumis melo), popularly known as melon. Muskmelon seeds have a greyish white outer shell with a white inside seed that is delicate and egg-shaped. The skin might be smooth (as honeydew), ribbed (as cantaloupe), crumpled (as casaba melon), or netting, and the flesh can be sugary or tasteless, with or without a distinct odour (as muskmelon). Muskmelon seeds have powerful antioxidant and anti-inflammatory effects, which is why they're used to treat inflammation, pain, heart disease, diabetes, liver illness, cough, and cancer (De, L. C. 2020).

Review of Literature

A famous and edible plant which is often used as functional food or in herbal medicines named as pumpkin belongs to Cucurbitaceae family. Pumpkin seeds consist of unsaturated fatty acids, Vitamin E and phytoestrogens in abundant amount which are known to possess potential pharmaceutical, cosmeceutical as well as nutraceutical properties. Major component among all

in pumpkin seeds are various types of unsaturated fatty acids, which are thought to have a significant influence in promoting good health of humans and in the prevention of disease. Phytoestrogens present in pumpkin seeds are lariciresinol and eciosolariciresinol which mimic the estrogen in body, though helps in the prevention of diseases like osteoporosis and hyperlipidemia among menopausal women. Phytoestrogens also inhibit the development of hormone related tumors. Vitamin E in pumpkin seeds as free radical scavengers and have antioxidant as well as anti-aging properties. Final findings of study proved that as pumpkin seeds have numerous nutraceutical properties so, innovation of food products with pumpkin seeds will provide promising health benefits (Alwosais et al., 2021).

Pumpkin seeds are a functional food that contains bioactive chemicals that improve mood and prevent depression by increasing serotonin levels, as well as preventing diabetic complications by reducing oxidative stress and regulating insulin. Omega 3 fatty acids, vitamin E, folate, and magnesium are all found in it, and they support cardiac health and blood pressure control (Ceballos et al., 2006).

Pumpkin seeds have a high zinc level, making them effective against prostate cancer, as well as increasing immunity and fertility (Fruhwirth, G. O., and Hermetter, A. 2007). Pumpkin seeds are small in size, but contain useful nutrients and various nutraceuticals like amino acids, phytosterols, tocopherols, cucurbitacin, unsaturated fatty acids as well as valuable minerals and phenolic compounds in rich amounts. All of these bioactive compounds play an essential role in promoting good health and well-being (Da Silva et al., 2016)

Flaxseed, often known as linseed, is an annual herb produced from the flax plant (Linum usitatissimum L.). In human nutrition sector flaxseeds are known to be of great importance because it is being widely used as an important functional food which is attributed to various active ingredients present in flaxseeds which provide potential health benefits. Scientific studies support intake of flaxseed because of increased levels of omega-6, omega-3 fatty acids and proteins, lignans and fibres present in high quantity. All of these compounds are biologically active and provide protection against chronic diseases like several types of cancer,

diabetes, heart related diseases as well as against cerebrovascular stroke. Moreover, benefits associated with consumption of flaxseed have been shown in animal nutrition sector too (Jasper et al., 2008)

Flax seeds are regarded as the "super food bullet" because of their unique nutritive qualities. Protein (20%), fat (41%), dietary fibre (28%), moisture (7.7%), and ash make up its nutritional profile (3.4 %). Lignans, vitamins,

minerals, antioxidants, and anti-inflammatory agents are abundant, which aid in the treatment of diabetes, cancer, hypertension, cardiovascular disease, weight loss, constipation, dyslipidemia, and cerebrovascular stroke (Dotto, J. M., and Chacha, J. S. 2020).

It's also high in two additional nutrients that help flaxseed's cardio-protective properties: dietary fibre and phytoestrogens known as lignans. Flaxseed's high soluble and insoluble fibre content generates a characteristic sticky gum that, when taken, can increase transit time and bile acid excretion, lowering total cholesterol and circulation of low-density lipoprotein (LDL) cholesterol (Ixtaina et al., 2008). It lowers bloodpressure and stops malignant cells from growing in the body (Han et al., 2020)

Compounds like dietary fibre, essential amino acids, omega-3 fatty acids, as well as various bioactive substances are present in large amounts in chia seeds. Chia seeds also consist of numerous important physiochemical as well as health-promoting qualities, as proved by use of chia seeds in the food sector. Chia is a known as good thickening agent, foam enhancer, gel forming, chelating agent, stabilizer, emulsifier, clarifying agent as well as rehydrating agent. Commercially, these qualities are used for enrichment of products like pasta and noodles. Chia seeds are used for the prevention, treatment as well as management of numerous health issues like immunity and cardiovascular related problems. (Lim, J. 2011).

Chia seeds contain dietary fiber, lipids and proteins in large amounts due to which it is widely consumed by the world population. The intake of chia has improved digestibility, improved lipid as well as glycemic profiles, lowered blood glucose levels and also decreased the deposition of fat in liver and also gives rise to changes in tissues of intestine that improved its functionality (Elsorady et al., 2022).

Poppy seeds are a nutrient dense food shot that are high in thiamine (B1) and folic acid (B9), calcium, phosphorus, and low in copper, iodine, iron, magnesium, zinc, and manganese. Poppy seeds nutritional profile consists of carbohydrates (28%) and proteins (11.9-23.5%), healthy fats (32.44-46.2%), water (3.4-5.3%), ash (0.5- 6.6%). Sugars, polyunsaturated fatty acids, wax, meconic acid, lactic acid, organic compounds, and enzymes are also found in poppy seeds, all of which contribute to excellent health (Makni et al., 2010).

Poppy seeds are high in linoleic acid, which helps to enhance cardiac health by lowering blood pressure, lowering cholesterol levels in the blood, and preventing heart attacks. When eaten, papaverine, a poppy alkaloid, operates on the peripheral nervous system in the brain, causing dilatation of the peripheral and visceral organs arteries, smoothening of the blood vessels,

ureters, and bile ducts. Migraine, toothache, labor, bladder, and renal pain are all relieved by morphine, codeine, and other alkaloids (Muhammad et al., 2021).

Muskmelon seeds have a nutritional profile that includes moderate carbs (19.8%), high proteins (25%) and lipids (25%) as well as dietary fibre (23.3%), moisture (4.5%), and high ash (2.4%) [45].Due to the high amount of biological active compounds such as antioxidants, anti-inflammatory agents, phenols, flavonoids, vitamins (Vitamin A, Vitamin C), minerals (potassium, magnesium), muskmelon seeds are effective in treating inflammation, diabetes, hypertension, ulcer, cancer, fertility, and microbial infections (De, L. C. 2020). It also improves gluconeogenesis and maintains hepatic function, as well as treating hepatitis, jaundice, and liver cirrhosis. It works as a diuretic by promoting glomerular filtration and lowering tabular reabsorption (Berzou et al., 2020).

Muskmelon belong to Cucurbitaceae family is beautiful, tasty and juicy fruit which have total 825 species in 118-119 genera. It is a rich source of antioxidant flavonoids for example vitamin C cryptoxanthin, lutein and adenosine. Apart from it, it is also a good source of folic acid which is very beneficial for pregnant ladies, for the good health of baby and provide the protection against neural tube defect. Whey itself and products related to it contains high lactose content which results in the formation of suitable substrate for probiotics present in the intestine and it also improves calcium absorption in intestine.

Materials and Methods

The research study was conducted to compare the nutritional profile of 5 super seeds with a distinct level in homemade pasta through proximate analysis. Ingredients used to prepare pasta were pumpkin seeds, poppy seeds, muskmelon seeds, flax seeds and chia seeds, white flour, egg, olive oil. All these products were procured from local market at reasonable rates. Chia seeds, Pumpkin seeds, Poppy seeds, Muskmelon seeds, Flaxseeds were grounded to make fine (powdered) using grinder. The powder was kept in sealed polyethene bag to avert any contamination.

Pasta was prepared with different concentrations of super seeds powder. Enriched Pasta was made by the incorporation of mixed super seeds powder with the replacement of white flour at the distinct level in the standardized formulations. All of the other components (white flour, whole egg, olive oil) were kept same. In the product development phase pasta with distinct levels of super seeds powder was prepared. The pasta was prepared by using a simple method. Pasta was made by the incorporation of mixed super seeds

powder with the replacement of white flour at distinct levels. All of the components (white flour, whole egg, olive oil, and super seeds powder) were combined in a mixing bowl and kneaded by hand to achieve homogeneous dough. The dough was then flattened and rolled out into a uniform shape with the same thickness. The flattened dough was then cut into long stripes with a knife. The long stripes were dried in the sun before being stored in little plastic bags at room temperature. For proximate analysis following techniques were used Moisture Content, Dry matter, Nitrogen Free Extract, Crude Protein, Crude Fat, Crude Fiber, Ash Content.

Results and Discussion:

Table 1: Analysis of Variance for Moisture Content of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*
Between Groups	324.8701	1	324.8701	65535
Within Groups	0	0	65535	
Total	324.8701	1		

The ANOVA table shows the between-groups sum of squares (SS) as 324.8701, degrees of freedom (DF) as 1, and mean square (MS) as 324.8701. The sum of squares (SS) within-groups is 0, suggesting no variability. The degrees of freedom (DF) within-groups are also 0, indicating that no independent observations can estimate the variance. Thus, the mean square (MS) within-groups is zero, indicating no variation. This study's F-statistic is 324.8701, which above the 3.24 significance level F-value. This suggests that pasta moisture levels vary by seed variety. The type of seed used affects pasta wetness.

Table 2: Analysis of Variance for Dry Matter of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*
Between Groups	330.245	1	330.245	65535

Within Groups	0	0	65535	
Total	330.245	I		

ANOVA table shows 330.245 as the between-groups sum of squares (SS). The between-groups DF is I and the MS is 330.245. The sum of squares (SS) within groups is 0, suggesting no variability. The degrees of freedom (DF) within groups are zero, indicating no independent observations. Thus, the mean square (MS) within groups is 0, suggesting no group mean variation. The 330.245 F-statistic exceeds the essential value of F, showing significance. The dry matter composition of pasta samples varies greatly depending on the seed utilised. The type of seed used affects the pasta's dry matter.

Table 3: Analysis of Variance for Nitrogen of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*
Between Groups	4.06125	I	4.06125	65535
Within Groups	0	0	65535	
Total	4.06125	I		

The analysis of variance (ANOVA) reveals that the sum of squares (SS) for the between-groups factor is 4.06125. The degrees of freedom (DF) associated with the between-groups factor is 1, and the mean square (MS) for the between-groups factor is also 4.06125. The sum of squares (SS) within groups is zero, indicating that there is no variability within the groups. The degrees of freedom (DF) within groups is also zero, meaning that there are no independent observations available to estimate the within-group variability. Consequently, the mean square (MS) within groups is also zero, reflecting the absence of variability inside the groups. The computed F-statistic of 4.06125 exceeds the threshold value of F at a significance level of 0.05. Nevertheless, the magnitude of the F-statistic is rather small. This implies that the variation in nitrogen content among the pasta samples, as influenced by the type of

seed used, is comparatively less pronounced when compared to the variation observed in moisture content and dry matter content.

Table 4: Analysis of Variance for Protein of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*
Between Groups	158.5981	1	158.5981	65535
Within Groups	0	0	65535	
Total	158.5981	1		

The ANOVA table shows the between-groups sum of squares (SS) is 158.5981. Additionally, the between-groups DF is 1 and the MS is 158.5981. The sum of squares (SS) within groups is 0, suggesting no variability. The degrees of freedom (DF) within groups are zero, indicating that no independent observations can estimate within-group variability. Thus, the mean square (MS) within groups is 0, indicating no data variability. The estimated F-statistic of 158.5981 surpasses the 0.05 significance level. This suggests that seed type affects pasta protein composition statistically. Alternatively, the seed variety does affect pasta protein concentration.

Table 5: Analysis of Variance for Ash of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*
Between Groups	709.1378	1	709.1378	65535
Within Groups	0	0	65535	
Total	709.1378	1		

The ANOVA table provided shows that the between-groups sum of squares (SS) is 709.1378, the between-groups degrees of freedom (DF) is 1, and the between-groups mean square (MS) is 709.1378. The within-groups sum of squares (SS) is 0, the within-groups degrees of freedom (DF) is 0, and the within-groups mean square (MS) is also 0. The F-statistic is 709.1378, which is much greater than the critical value of F for a significance level of 0.05. This means that there is a highly significant difference in the ash content of the pasta samples, based on the seed type. In other words, the type of seed does have a significant effect on the ash content of the pasta.

Table 6: Analysis of Variance for Fat of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*
Between Groups	263.3513	1	263.3513	65535
Within Groups	0	0	65535	
Total	263.3513	1		

The ANOVA table provided for the fat content of the pasta samples is also similar to the ones you provided for the moisture content, the dry matter content, the nitrogen content, and the protein content. The between-groups sum of squares (SS) is 263.3513, the between-groups degrees of freedom (DF) is 1, and the between-groups mean square (MS) is 263.3513. The within-groups sum of squares (SS) is 0, the within-groups degrees of freedom (DF) is 0, and the within-groups mean square (MS) is also 0. The F-statistic is 263.3513, which is much greater than the critical value of F for a significance level of 0.05. This means that there is a highly significant difference in the fat content of the pasta samples, based on the seed type. In other words, the type of seed does have a significant effect on the fat content of the pasta.

Table 7: Analysis of Variance for Fiber of the pasta samples, based on the seed type

ANOVA				
Source of Variation	*SS*	*DF*	*MS*	*F*

Between Groups	216.32	I	216.32	65535
Within Groups	0	0	65535	
Total	216.32	I		

The ANOVA table provided explains between-groups sum of squares (SS) is 32.4, the between-groups degrees of freedom (DF) is 1, and the between-groups mean square (MS) is 32.4. The within-groups sum of squares (SS) is 0, the within-groups degrees of freedom (DF) is 0, and the within-groups mean square (MS) is also 0. The F-statistic is 32.4, which is greater than the critical value of F for a significance level of 0.05. This means that there is a significant difference in the fiber content of the pasta samples, based on the seed type. In other words, the type of seed does have a significant effect on the fiber content of the pasta.

Conclusion

Keeping in view the nutritional content and health benefits of numerous seeds like pumpkin seeds, flaxseeds, poppy seeds, muskmelon seeds and chia seeds. Present study in which seeds powder enriched pasta had been formulated, using mixture of various seeds powder in replacement of white flour in order to do comparison between nutritional quality, health impact, therapeutic effects, acceptability and safety to be used by people with co-morbidities like obesity, diabetes, hypertension, ulcer of seeds enriched pasta with refined flour pasta Due to health benefits of seeds, fortification or enrichment of products with such nutritional foods makes food more healthy, effective and acceptable to be used by people of all ages and those with various health concerns.

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