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Incorporation and optimization of chickpea in tofu

MARIYA THERESA K[1], Dr. D. RADHAPRIYA [2]
[1] *MSC. Food and Nutrition, Dept of Food Science and Nutrition, Dr. NGP Arts and Science College, Coimbatore - 048.*
[2] *Assistant Professor Dept of Food Science and Nutrition, Dr. NGP Arts and Science College, Coimbatore -048..*

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Corresponding Author:
MARIYA THERESA K

Abstract:

Tofu is a staple protein source and is traditionally made from soybeans. The incorporation of chickpea into tofu offers an innovative approach to enhancing the nutritional value and sensory appeal of traditional tofu. This study aimed to formulate and optimize chickpea-incorporated tofu using five different ratios of soy milk and chickpea milk: 50:50, 60:40, 70:30, 80:20, and 90:10. Sensory evaluation was conducted based on texture, flavour, and overall acceptability. Among the formulations, the 60:40 ratio achieved the highest sensory scores and showed better consumer preference. Cost analysis showed costs of ₹135, ₹154, ₹173, ₹194, and ₹215 for the respective formulations. Considering sensory acceptability and cost-effectiveness, the 60:40 ratio was selected as the optimal formulation. The study indicates that chickpea-incorporated tofu can be a nutritious and economically feasible food product with potential for further development.

Keywords: Tofu, Chickpea, Soy Milk, Chickpea Milk, Nutritional Value, Sensory Evaluation, Texture, Flavour, Overall Acceptability, Cost Analysis, Economic Feasibility, 60:40 Ratio, Optimal Formulation

1. INTRODUCTION

Tofu, a staple protein source in many Asian cuisines, is traditionally made from soybeans. However the incorporation of alternative legumes, such as chickpeas (Cicer arietinum) presents a promising avenue for enhancing the nutritional profile and sensory attributes of tofu. Chickpeas, known for their high protein content, dietary fibre, and essential micronutrients, offer several advantages when integrated into tofu production.

Chickpeas are rich in protein, offering a complementary amino acid profile to that of soybeans. According to studies, the addition of chickpeas can enhance the protein content of tofu, resulting in a more balanced nutritional profile, including increased levels of dietary fibre, vitamins, and minerals This is particularly beneficial for individuals seeking plant-based protein sources. (Gaur et al. 2021; Shukla et al., 2020).

The rising popularity of veganism and vegetarianism has led to increased consumer demand for innovative plant-based foods. Incorporating chickpeas into tofu caters to health-conscious individuals seeking alternative protein sources that are both nutritious and satisfying (Ghosh et al., 2020).

The incorporation of chickpeas into tofu presents a compelling fusion of nutritional benefits, culinary versatility, and sustainability. Chickpeas are a rich source of protein, fiber, vitamins, and minerals, enhancing the overall nutritional profile of tofu. They provide essential nutrients such as folate, iron, and magnesium, which are crucial for a balanced

diet (Hassan et al., 2016). This combination results in a product that is not only higher in protein content but also offers additional health benefits, making it an excellent choice for plant-based diets (Dreher & Davenport, 2013).

Combining chickpeas with tofu creates a synergistic effect that enhances the bioavailability of nutrients. For instance, the high fibre content in chickpeas aids in digestion and promotes satiety, which can be particularly beneficial for individuals seeking to manage their weight (Stoffel et al., 2021).

Additionally, chickpeas contain essential amino acids that complement the protein profile of tofu, making the resulting product a complete protein source, which is especially important for those following plant-based diets (Messina, 2016). The combination also improves the overall digestibility of the protein, allowing for better absorption of nutrients by the body.

Culinarily, the addition of chickpeas diversifies the texture and flavour of tofu, offering innovative possibilities in various dishes. Chickpeas impart a nuttier taste and a creamier texture, broadening the appeal of tofu in recipes ranging from salads and dips to main courses and snacks.

This innovation aligns with consumer trends favouring diverse and flavourful plant-based options. For example, chickpea tofu can be used in dishes like curries, stir-fries, or even baked goods, providing a unique twist on traditional recipes. Furthermore, the combination can enhance the sensory attributes of tofu, making it more appealing to a broader audience, including those who may be less inclined to consume soy products. (Berk et al., 2018).

From a sustainability perspective, both chickpeas and tofu are recognized for their lower environmental impact compared to animal-based protein sources. The cultivation of chickpeas requires less water and has a lower carbon footprint than livestock farming, making it an eco-friendly alternative for protein production. This shift toward plant-based diets is crucial in addressing global challenges related to food security and climate change (Jalali & Rahimi, 2023).

In conclusion, the integration of chickpeas into tofu offers a multitude of benefits, ranging from enhanced nutritional profiles and culinary versatility to sustainability and alignment with consumer trends. This innovative approach not only responds to the needs of health-conscious individuals but also addresses pressing environmental challenges. As the demand for plant-based proteins continues to rise, the fusion of chickpeas and tofu stands out as a promising solution in the quest for a healthier and more sustainable future.

OBJECTIVES

1. To extract the milk from selected legumes soyabean and chickpea
2. Formulation of tofu using chickpea milk and soyabean milk.
3. Sensory evaluation of formulated chickpea incorporated tofu
4. Cost analysis

2. REVIEW OF LITERATURE

The study entitled **Incorporation and optimization of chickpea in tofu** was reviewed under the following topics.

1.Soyabean

a) Extraction of soyabean milk

b) Health benefits of soyabean

2.Chickpea

a) Extraction of chickpea milk

b) Health benefits of chickpea

3.Nutritional composition

a) Nutrient status of soyabean

b) Nutrient status of chickpea

4.Market potential of tofu

1.Soyabean:

a.Extraction of soyabean milk

Soybean contains up to 40% of protein, of which 90% is water extractable. Therefore, it is a very economical protein source compared with animal protein. In addition, it has many unique properties and physiological functions. Soybean is free of lactose, and can be used to make infant formula for lactose-intolerant people.

In 1999, a health claim was approved by the Food and Drug Administration (FDA) that intake of 25 g of soy protein every day in conjunction with a low-cholesterol and low saturated fat diet could prevent heart disease (FDA, 1999).

Extraction of solid is correlated with grinding temperature. Winston et al. (1968) found grinding at 55-65°C resulted in the highest solid recovery. They also found grinding at 85 °C and above lead to substantial decreases of soymilk volume and solid recovery and attributed it to gel formed at high temperatures. Using heating and mannual squeezing, Endo et al. found hot grinding at 95 °C gave significantly lower soymilk yield, protein and solid recovery compared with ambient grinding. Endo et al. (2004)

Johnson and Snyder further stated that blanching and hot grinding all gave lower solid recovery than ambient grinding with the former decreasing even more. When soybean powder was used, hot grinding still gave the lowest protein recovery (Mizutani and Hashimoto, 2004)

Solid recovery increased with water-to-bean ratio and the ratio could affect the composition of soymilk . Johnson and Snyder (1978) established that during grinding, two processes happened concurrently: water extraction of soluble

solids and breaking of large particles. Higher water-to-bean ratio favored the former process and 7 lower water-to-bean ratio was conducive to the latter process. (Johnson and Snyder, 1978)

Beddows and Wong demonstrated that 10:1 water to-bean ratio could yield more protein and solid in soymilk compared with 8:1 ratio, but the double extraction of 8:1 plus 2:1 ratio could give 3.3% higher protein recovery than a single 10:1 ratio extraction. The extraction efficiency of solid and protein is also affected by the degree of hydration. Beddows and Wong (1987a).

b. Health benefits of soyabean:

Soybeans are a highly nutritious food source, renowned for their impressive protein content. Comprising about 36-40% protein by weight, soybeans are one of the few plant foods that offer a complete protein profile, containing all nine essential amino acids. This makes them an excellent protein source for vegetarians and vegans who may struggle to find adequate protein in their diets. Products such as tofu, tempeh, and soy milk provide versatile options that can be incorporated into various dishes, promoting a balanced intake of nutrients while also satisfying protein needs (Messina, 2016).

In addition to their protein content, soybeans have been linked to significant cardiovascular benefits. Research has consistently shown that consuming soy protein can lower levels of LDL cholesterol (the "bad" cholesterol) and overall cholesterol levels, reducing the risk of heart disease.

A pivotal meta-analysis conducted by Anderson et al. found that soy protein intake is associated with a significant reduction in serum cholesterol, highlighting the heart-protective properties of soy. Furthermore, the isoflavones present in soy, particularly genistein and daidzein, contribute to cardiovascular health by improving endothelial function and reducing inflammation, which are critical factors in preventing heart disease. Anderson et al. (1995)

Soybeans also play a crucial role in supporting bone health, particularly among postmenopausal women. The decline in estrogen levels after menopause can lead to decreased bone density, increasing the risk of osteoporosis. Soy isoflavones mimic estrogen in the body and have been shown to help maintain bone density and overall bone health.

A study by Kuhl et al. noted that women consuming soy products experienced reduced bone loss compared to those who did not, suggesting that incorporating soy into the diet may help mitigate some of the adverse effects of menopause on bone health. Thus, soy serves as a beneficial dietary intervention for aging women. Kuhl et al. (2012)

Another significant benefit of soybeans is their potential to alleviate menopausal symptoms. Many women experience symptoms such as hot flashes and mood swings during menopause, which can affect their quality of life. The phytoestrogens found in soy can help balance hormones and reduce these symptoms. Research indicates that women who consume soy isoflavones report fewer and less severe hot flashes, as highlighted by a review published in

Menopause (Kuhl et al., 2012). This hormonal balance not only improves quality of life during menopause but may also support overall reproductive health. (Kuhl et al., 2012).

Additionally, soy's low glycemic index means it causes slower increases in blood sugar, making it a favorable choice for those managing diabetes or seeking to prevent metabolic disorders. Incorporating soybeans into a balanced diet can thus provide multiple health benefits while supporting weight management and metabolic health

2.Chickpea

a.Extraction of chickpea milk

Chickpea milk is an emerging plant-based alternative to dairy milk, renowned for its nutritional profile and versatility in culinary applications. The extraction process begins with the careful selection of high-quality chickpeas (Cicer arietinum), which are then soaked in water for 8 to 12 hours. This soaking step is crucial as it softens the chickpeas, making them easier to blend and enhancing their digestibility.

Additionally, soaking activates enzymes that improve the nutritional quality of the final product, allowing for better absorption of essential nutrients. Once soaked, the chickpeas are drained, rinsed, and prepared for blending. For more details on the soaking process and its benefits, see the article by Zeng et al. (2020)

In the next stage, the soaked chickpeas are combined with water at a ratio of approximately 1:3 (chickpeas to water) and blended at high speed for about 2 to 3 minutes. This blending process is key to extracting the soluble proteins, vitamins, and minerals present in the chickpeas, resulting in a creamy and smooth mixture.

The quality of the milk can vary depending on the duration of blending and the ratio of water used, which allows for customization based on personal preference for thickness and texture.

After blending, the mixture is then strained through a fine mesh strainer or cheesecloth to separate the liquid from the solid residue, known as chickpea pulp or okara. A comprehensive discussion of the blending process can be found in the study by Arora et al. (2019),

To maximize the yield of liquid chickpea milk, the pulp is often pressed firmly using a spoon or a nut milk bag. The extracted liquid is then ready for consumption, but it can also be flavoured to enhance its taste. Common flavourings include sweeteners such as agave syrup or maple syrup, vanilla extract, or even a pinch of salt. For those looking to boost the nutritional content, fortifying the milk with calcium carbonate is a popular option, which increases its calcium levels, making it a more comparable alternative to dairy milk. The fortification and flavouring options are detailed in the article by Saeed and Khan (2021),

Chickpea milk offers numerous health benefits, making it an appealing choice for those seeking a nutritious plant-based option. With approximately 8 grams of protein per cup, it serves as an excellent source of plant-based protein. Additionally, chickpea milk is high in dietary fiber, which aids in digestion and promotes a feeling of fullness. It also

contains essential vitamins and minerals such as folate, magnesium, and iron, contributing to its status as a wholesome alternative to traditional dairy products. Furthermore, the low allergenic potential of chickpeas compared to other plant-based milks, like almond or soy milk, makes chickpea milk suitable for individuals with nut allergies. For a deeper exploration of the nutritional profile of chickpea milk, refer to the research conducted by Zafar et al. (2022)

b. Health benefits of chickpea:

Heart Health: Chickpeas contain nutrients like magnesium and potassium, which are known to support heart health. Their fibre content helps lower cholesterol levels, reducing the risk of heart disease

Blood Sugar Regulation: Chickpeas have a low glycemic index and contain resistant starches that help slow down digestion. This makes them ideal for blood sugar control, especially in individuals with diabetes or insulin resistance

Bone Health: Due to their high content of essential minerals like calcium, magnesium, and phosphorus, chickpeas support bone strength and can help in preventing conditions like osteoporosis(Singh, B.,&Singh, J.P.(2017) **Weight Management**: Chickpeas are nutrient-dense and help with weight management by promoting a feeling of fullness, reducing overall calorie intake without sacrificing nutrition.

Anti-inflammatory and Antioxidant Properties: Chickpeas contain antioxidants like polyphenols and flavonoids that help reduce inflammation and protect cells from oxidative stress, which is linked to aging and chronic diseases

Gut Health: The soluble fibre in chickpeas acts as a prebiotic, feeding healthy gut bacteria, which in turn supports gut health and improves immune function

Cognitive Benefits: The folate content in chickpeas is essential for brain function and mental health. Adequate folate intake may help reduce the risk of cognitive decline and depression(Pellegrini, N., et al.(2020)

3.Nutritional composition

a. Nutritional status of soyabean :

Soybean (Glycine max) is recognized globally as a highly nutritious legume, integral to various diets, particularly in vegetarian and vegan communities. Its comprehensive nutritional profile includes significant amounts of protein, healthy fats, carbohydrates, vitamins, and minerals. This literature review explores the key nutritional components and health benefits associated with soybean consumption based on recent research findings.

Protein Content:

Soybeans are renowned for their exceptional protein content, which ranges from 36 to 40 grams per 100 grams of raw seeds (Ajala & Oloyede, 2020). This high protein concentration makes soybeans one of the richest plant-based protein sources, containing all essential amino acids, a characteristic that distinguishes soy from many other legumes. This

feature is particularly beneficial for individuals seeking plant-based protein alternatives, allowing for diverse dietary applications.

Fat Composition:

In addition to protein, soybeans are composed of approximately 20 grams of fat per 100 grams, primarily in the form of unsaturated fatty acids The presence of omega-3 and omega-6 fatty acids contributes to heart health and reduces inflammation, making soybean oil a healthy option for culinary uses. The fatty acid profile of soybeans supports their role in reducing the risk of cardiovascular diseases (Rajarathnam et al., 2021)..

Carbohydrates and Dietary Fiber:

Soybeans contain around 30 grams of carbohydrates, of which about 9 grams are dietary fiber .The fiber content is crucial for digestive health, aiding in regular bowel movements and promoting satiety, which can assist in weight management. The complex carbohydrates present in soybeans provide a steady source of energy, making them a valuable addition to balanced diets. (Rajarathnam et al., 2021)..

Vitamins and Minerals

Soybeans are rich in essential vitamins and minerals.the presence of several B-complex vitamins, including thiamine, riboflavin, niacin, and folate, all of which are vital for energy metabolism and overall health. Furthermore, soybeans are a good source of vitamin K, which is important for blood clotting and bone health. Rajarathnam et al. (2021)

The mineral content of soybeans is equally impressive. They provide significant amounts of calcium, iron, magnesium, phosphorus, and potassium Calcium is essential for bone health, while iron is critical for oxygen transport in the bloodstream. Magnesium plays a role in over 300 enzymatic reactions in the body, and potassium is vital for maintaining healthy blood pressure levels. (Rajarathnam et al., 2021).

Phytoestrogens and Antioxidants:

One of the unique features of soybeans is their high content of isoflavones, a class of phytoestrogens that can mimic estrogen in the body. Messina discusses the health benefits of these compounds, which have been associated with a reduced risk of certain cancers, particularly breast and prostate cancer. Isoflavones also contribute to cardiovascular health by improving lipid profiles and reducing arterial stiffness Messina (2016)

b.Nutritional status of chickpea:

Chickpeas (Cicer arietinum), a popular legume, are valued not only for their culinary versatility but also for their impressive nutritional profile and health benefits. This review synthesizes findings from various studies that highlight the nutritional aspects of chickpeas and their contributions to health.

Proteins: Chickpeas are an excellent source of plant-based protein, containing essential amino acids that support muscle growth and repair. They are particularly high in lysine, an amino acid often limited in grains, making them a valuable complement to cereal-based diets.

Fats: The fat content in chickpeas is relatively low and primarily consists of polyunsaturated and monounsaturated fatty acids, which are beneficial for heart health (Graham et al., 2017).

Carbohydrates: Chickpeas are rich in complex carbohydrates, providing sustained energy and contributing to a low glycemic index, which is beneficial for managing blood sugar levels (Shafique et al., 2020).

Macronutrients: Chickpeas are an excellent source of plant-based protein, providing approximately 8.9 g of protein per 100 g of cooked legumes (Rani & Singh, 2019). They are low in fat, containing about 2.6 g, primarily composed of healthy unsaturated fats. The carbohydrate content is around 27.4 g, which includes a substantial amount of dietary fiber (7.6 g), contributing to their low glycemic index (Gaur & Sharma, 2020).

Vitamins and Minerals: Chickpeas are rich in essential vitamins and minerals. They contain significant amounts of folate (172 µg), which is crucial for DNA synthesis and repair, making them particularly important during pregnancy They also provide key minerals such as iron (2.9 mg), magnesium (48 mg), phosphorus (168 mg), and potassium (291 mg), which are vital for various bodily functions, including bone health and muscle contraction (Gaur & Sharma, 2020). (Ali & Yadav, 2021).

Phytochemicals: In addition to macronutrients and micronutrients, chickpeas contain bioactive compounds such as flavonoids and phenolic acids. These phytochemicals possess antioxidant properties, which can help reduce oxidative stress and inflammation in the body (Rani & Singh, 2019).

4.Market Potential of Tofu:

Growing Plant-Based Market: The demand for plant-based proteins, including tofu, is increasing significantly. A report by Research and Markets (2022) projects that the global plant-based protein market will reach approximately $27.9 billion by 2027, driven by consumer shifts toward healthier eating habits.

Nutritional Benefits: Tofu is recognized for its health benefits, being a high-quality protein source with essential amino acids. According to the Journal of Agricultural and Food Chemistry (2020), tofu is associated with health benefits, including reducing the risk of chronic diseases such as heart disease and diabetes.

Sustainability and Environmental Concerns: Tofu production has a lower environmental impact compared to animal proteins. A study in Nature Communications (2021) emphasizes that plant-based diets, including tofu, can help reduce greenhouse gas emissions and overall environmental degradation.

Market Growth Trends: The tofu market is expected to grow significantly. The Global Tofu Market Report by Market Research Future (2023) forecasts that the tofu market will expand at a CAGR of approximately 5.1% from 2022 to 2027, driven by increasing vegetarianism.

Culinary Versatility: Tofu's versatility in various cuisines enhances its market appeal. An article in Food Science & Nutrition (2021) discusses how tofu can be incorporated into diverse culinary applications, increasing its attractiveness to a broader consumer base.

Consumer Preferences: A study published in the International Journal of Consumer Studies (2021) notes that younger consumers are increasingly seeking plant-based alternatives, contributing to a growing interest in tofu products.

Innovation in Tofu Products: The introduction of new flavors and varieties, such as flavored or organic tofu, has broadened the market. According to Food Technology Magazine (2022), innovation in plant-based products is a key factor driving consumer interest and sales.

Impact of COVID-19: The pandemic has heightened awareness of health and nutrition, boosting the demand for plant-based foods, including tofu. A report from The Good Food Institute (2021) highlights that the plant-based sector saw increased sales during the COVID-19 pandemic.

Retail Expansion: The rise of e-commerce has facilitated the distribution of tofu products. A report by Nielsen (2021) outlines the growth of online grocery shopping, which has made plant-based options more accessible to consumers.

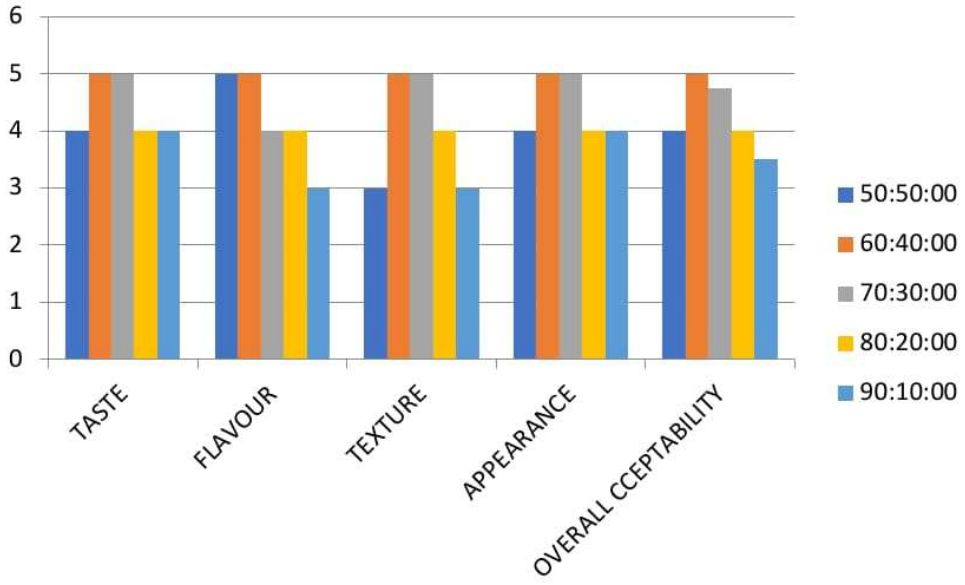
Global Markets: Tofu is particularly popular in Asia but is gaining traction in Western markets. The FAO (Food and Agriculture Organization) report (2020) indicates that the demand for tofu is rising in North America and Europe, driven by the increasing popularity of Asian cuisine.

3. RESULTS AND DISCUSSION

1.Sensory analysis

2.Cost analysis

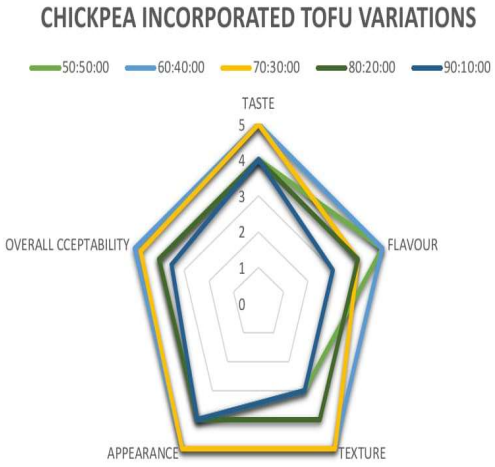
SENSORY EVALUATION OF FIVE VARIATIONS (CHICKPEA INCORPORATED TOFU)



1. The sensory analysis was done in five variations (soyabean:chickpea) milk for the chickpea incorporated tofu in the ratio (50:50,60:40,70:30,80:20,90:10) and the results were discussed.

The graph represents the sensory analysis of different variations in chickpea incorporated tofu.(soy milk and chickpea milk).Each combination is evaluated on a 5-point hedonic scale, where higher values indicates the greater preference.

The ratio of (60:40) variation had scored the highest. And the ratio of (70:30) had scored the second among the five variations.



The chickpea incorporated soy tofu was made in five variations

The 50:50 ratio had a hard and rubbery texture due to higher starch content

The 60:40 ratio tofu had a perfect firm soft silky texture

The 70:30 ratio tofu had a very tendery texture

The 80:20 ratio tofu had more silky and extremely soft texture .

The 90:10 ratio tofu mostly tasted like standard tofu and there is only 10% of chickpea milk were added .

The finalised ratio was 60:40 with additional of 15 ml vinegar to it .

1.Texture:

Smoother, Silkier Texture With a higher proportion of soy milk, the texture is expected to be smoother and closer to traditional soy tofu. The graininess from the chickpea milk will be reduced, as soy proteins are more dominant.

2. Firmness:

The tofu would likely resemble a medium firmness—less dense than tofu made with a 50:50 ratio but still slightly creamier than pure soy tofu. It should hold its shape relatively well, making it versatile for slicing and stir-frying, though it might be a bit softer than firm tofu.

2. Color:

The tofu will have a light beige or pale yellow hue due to the chickpea milk. This color difference would be subtle but noticeable compared to the typically whiter soy-only tofu.

3.Flavour:

Mild, Nutty Undertone: Soy tofu has a mild flavor, while chickpeas add a nutty, earthy undertone. This 60:40 mix should have a delicate, slightly sweet flavor with a mild nuttiness from the chickpeas, making it suitable for both savory and slightly sweet recipes.

4.Nutritional Profile:

This ratio provides a balanced blend of proteins from both chickpeas and soybeans, offering a tofu rich in essential amino acids and fiber from the chickpeas. It may also have a slightly different fat and carbohydrate profile, which can affect mouthfeel and creaminess.

4. Discussion

1. Versatility in Cooking: A 60:40 soy-to-chickpea tofu would be adaptable in the kitchen. It can be used in stir-fries, baked, or added to soups without falling apart as easily as softer tofu. However, its slightly softer, creamier texture also makes it ideal for blended or mashed applications, like sauces or spreads.

2. Suitability for Different Cuisines: The mild nuttiness and creaminess could lend well to dishes that benefit from a little extra flavor depth. It would work well in Middle Eastern or Mediterranean dishes where chickpea flavors are appreciated, as well as in traditional tofu recipes.

3. Challenges in Coagulation: Depending on the coagulant used, you might notice that chickpea proteins don't coagulate as efficiently as soy proteins. This could make the tofu slightly softer and less cohesive than pure soy tofu. Using a bit more coagulant may help create a firmer texture, but it's important to avoid an overly high concentration, which could result in a bitter taste.

In summary, a 60:40 soy-to-chickpea tofu will have a unique texture that's smoother than a 50:50 mix but creamier and softer than traditional soy tofu, with a subtle nuttiness and a mild, balanced flavor. This ratio creates a tofu that's both versatile and appealing for a variety of dishes while offering a unique twist on the usual tofu profile.

COST ANALYSIS:

1 Variation I

Table ## - Cost analysis for Variation I

S.NO	INGREDIENTS	QUANTITY	MARKET PRICE	PRODUCTION COST	TOTAL AMOUNT(Rs)
1	Soyabean	200g	40	10	50
2	Chickpea	200g	45	10	55
3	Vinegar	10ml	20	10	30
				TOTAL	135

The Total cost for variation I was Rs 135 in total.

2 Variation II

Table ## - Cost analysis for Variation II

S.NO	INGREDIENTS	QUANTITY	MARKET PRICE	PRODUCTION COST	TOTAL AMOUNT (Rs)
1	Soyabean	240g	54	10	64
2	Chickpea	160g	50	10	60
3	Vinegar	10ml	20	10	30
				TOTAL	154

The Total cost for variation II was Rs.154 in total.

3 Variation III

Table ## - Cost analysis for Variation III

S.NO	INGREDIENTS	QUANTITY	MARKET PRICE	PRODUCTION COST	TOTAL AMOUNT (Rs)
1	Soyabean	280g	68	10	78
2	Chickpea	120g	55	10	65
3	Vinegar	10ml	20	10	30
				TOTAL	173

The Total cost for variation III was Rs.173 in total.

4 Variation IV

Table ## - Cost analysis for Variation IV

S.NO	INGREDIENTS	QUANTITY	MARKET PRICE	PRODUCTION COST	TOTAL AMOUNT (Rs)

1	Soyabean	320g	84	10	94
2	Chickpea	80g	60	10	70
3	Vinegar	10ml	20	10	30
				TOTAL	194

The Total cost for variation IV was Rs.194 in total.

5 Variation V

Table ## - Cost analysis for Variation V

S.NO	**INGREDIENTS**	**QUANTITY**	**MARKET PRICE**	**PRODUCTION COST**	**TOTAL AMOUNT (Rs)**
1	Soyabean	360g	100	10	110
2	Chickpea	40g	65	10	75
3	Vinegar	10ml	20	10	30
				TOTAL	215

The Total cost for variation V was Rs.215 in total.

The cost calculation of incorporation and optimization of chickpea in tofu was done based on the cost of pedients in market along with the production cost.

5. SUMMARY AND CONCLUSION

The development and optimization of tofu enriched with chickpeas, focusing on improving its nutritional profile, texture, and potential health benefits. Traditional tofu, typically made from soybeans, is a staple protein source in many diets; however, incorporating chickpeas provides an alternative that enhances the product's dietary fiber, micronutrient, and protein content. The study examines various formulation methods to balance flavor, texture, and nutritional value, ultimately creating a tofu with a desirable consistency and improved health benefits. Key factors assessed include protein levels, amino acid profile, texture measurements, and overall consumer acceptance.

The incorporation of chickpeas into tofu offers a promising alternative to traditional soy-based tofu, providing additional health benefits through increased fiber, essential amino acids, and micronutrients such as iron and magnesium. The optimized formulation results in a product with a favourable texture and taste, which could appeal to a broad range of consumers seeking plant-based protein options. The findings suggest that chickpea-enriched tofu could be a valuable addition to the market, promoting both nutritional diversity and sustainability in plant-based foods. Further research on scalability and consumer education may enhance its potential impact and acceptance in the food industry.

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