COTTONSEED AS A FUNCTIONAL INGREDIENT: A COMPREHENSIVE REVIEW ON NUTRITIONAL VALUE, PROCESSING AND FOOD APPLICATIONS

Akshaya K[1*], Aswin S[1], Durgadevi S[1], Keveena A. S[1], Pazhanivelraja S[1], Nageswari G[2]

[1]Bachelor of Food Technology, Department of Food Technology, Sri Shakthi Institute of Engineering and Technology, Coimbatore-641062

[2]Assistant Professor, Department of Food Technology, Sri Shakthi Institute of Engineering and Technology, Coimbatore- 641062.

Abstract

Cottonseed is an important by-product of the cotton industry and is widely used for extracting oil and producing value-added products. This review focuses on the processing, composition, and diverse uses of cottonseed, including its applications in producing cottonseed milk, ice cream, flavoured milk, flour, and oil. Cottonseed contains high-quality proteins, healthy oil, and dietary fiber, making it suitable for both food and industrial purposes. Cottonseed oil is valued for its mild flavour and stability, while cottonseed flour is rich in protein and is gaining attention for its use in bakery and health-food formulations. Recently, cottonseed milk and ice cream have emerged as promising plant-based alternatives to dairy products, offering good nutrition and creamy texture. This review highlights the potential of cottonseed to the development of nutrient rich and innovative products, while contributing to agricultural and industrial growth.

Keywords: *Cottonseed, Cottonseed milk, Flavoured milk, Ice-cream, Flour, Oil, Protein*.

Introduction

Cottonseed is obtained from the cotton plant after removing the fiber during the ginning process. Although cotton is mainly cultivated for its fiber, the seed left behind is a valuable by-product with many uses. It is rich in oil, protein, and other nutrients that can be used in food, feed, and industrial products. The oil extracted from cottonseed is used for food preparation, while the remaining parts are used for making animal feed and fertilizers. In recent years, researchers and industries have developed new uses for cottonseed, such

as making cottonseed milk, ice cream, flavoured milk, flour, protein and oil. Cottonseed milk is a plant-based beverage made from processed cottonseed kernels. It is rich in protein with a mild flavour, making it suitable for lactose-intolerant individuals and those who prefer dairy-free options. Cottonseed based ice cream also utilizes the natural fat and protein in cottonseed to achieve a creamy texture like traditional ice cream. In addition to beverages and frozen desserts, cottonseed is used to produce flour and protein ingredients for bakery and plant-based foods, while cottonseed oil serves as a stable and neutral tasting cooking oil. This report explains the processing steps involved in handling cottonseed, its nutritional composition, and the growing importance of cottonseed-based products in the food industry. It also highlights how cottonseed contributes to the economy and promotes sustainable use of agricultural resources.

Cottonseed

Cottonseed, which comes from the *Gossypium* plant, has been gaining a lot of attention as a rich and sustainable plant-based protein source. Around the world, it contributes nearly 10 million metric tons of protein each year (Kumar et al., 2023). Nutritionally, cottonseed is well-balanced; it's packed with proteins, healthy fats, carbohydrates, and fiber, along with essential minerals. After oil extraction, the processed seed meal typically contains about 30–50% protein and 19–38% fat and carbohydrates, depending on how it’s processed. Because of this rich nutrient profile, cottonseed has great potential as a source of food and feed. However, one major challenge with cottonseed is the presence of pigment glands found in some varieties. These glands contain gossypol, a naturally occurring compound that can be toxic in high amounts. Gossypol can bind to amino acids like lysine, which reduces the nutritional value of the protein (Ramaswami, 1969; Conkerton & Frampton, 1959). To tackle this problem, early scientists developed glandless cotton varieties (Harper, 1962), but they faced difficulties with seed quality and processing (Kim *et al.,* 1971). More recent studies have focused on removing gossypol effectively while keeping the protein quality intact. For instance, Glenn (1970) showed that a two-step solvent extraction method can significantly reduce gossypol levels, and Satankar *et al*. (2023) used advanced optimization techniques to achieve similar results. With new chemical and biological methods emerging, cottonseed is becoming a much safer and more valuable source of protein (Kumar *et al*., 2023).

Table: 1 Mineral Composition of Cottonseed

Mineral	Content (mg/g)	Key Role/ Significance
Potassium (k)	126.7±05.77 (Most abundant)	Regulates water and electrolyte balance in the body
Sodium (Na)	12.5 (Low content)	Helps regulate acid- base balance and prevent nerve/muscle contraction. Low content is beneficial as high sodium can induce hypertension
Magnesium (Mg)	7.45 (Moderate level)	Crucial for nucleic acid structure stability; aids in electrolyte absorption
Calcium (Ca)	7.4±0.02 (Moderate level)	Essential for strong bones/ teeth, proper blood clotting, and Nervous system function. Moderate level is desirable, deficiency causes rickets/decay, excess affects phosphorus
Iron (Fe)	0.1±0.01(Trace amount)	Aids oxygen binding to hemoglobin and controls infection.
Zinc (Zn)	0.01±0.00(Trace amount)	Assists in wound healing. Trace amount is key, excess can induce anemia, and deficiency causes dermatitis.

The above tabulation has been adapted from Zubair MF *et al.,* 2021

Cottonseed Milk

Cottonseed milk is another source of nutrient rich food product for human beings. According to Sathiya et al. (2024), the preparation process begins with the collection of cottonseeds, followed by cleaning to remove impurities such as dirt and dust. The seeds are then soaked in water for around 12 hours to soften them, which also aids in reducing anti-nutritional factors. Cottonseed milk is plant-based milk substitute extracted from detoxified cottonseed. After soaking, the softened seeds are wet-milled with water to form a slurry, which is subsequently filtered to obtain the liquid extract. As noted by Kumar (2019) in the Journal of Ethnic Foods, the extracted milk undergoes pasteurization under controlled heating conditions to eliminate microbial contaminants and improve shelf-life. Praveena and Subarathinam (2021) further reported that the milk is rapidly cooled after pasteurization to retain nutritional quality and ensure product stability.

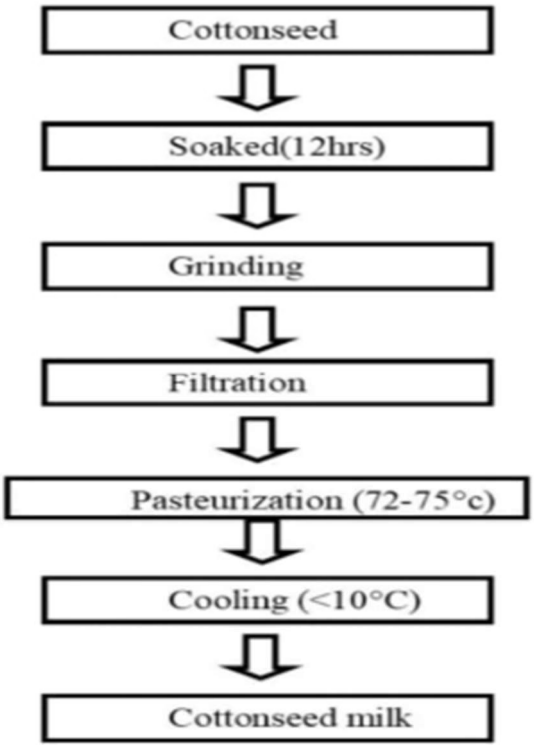

Figure: 1 Cottonseed Milk Extraction

The above flowchart has been adapted from Sathiya et al., (2024), Manoj, (2019), M.Praveena, R. Subarathinam, (2021)

Flavoured Cottonseed Milk

The researchers aimed to develop a nutritious and alternative to traditional dairy, particularly for individuals who are lactose-intolerant or malnourished. The study highlights the use of sapota and cotton seed milk to create a flavored milk product. The researcher tested three different concentrations of sapota pulp: 10%, 20%, and 30%. Following sensory evaluation, the best-rated formulation 30% was subjected to detailed analysis of its nutritional, physico-chemical, and microbial properties. (M.Praveena,R.Subaratinam et al.,2021)

Table.2 Nutrient Content of Sapota Flavoured Milk

Nutrient	Sapota Flavoured Cotton Seed Milk
Energy (kcals)	166.5
Protein (g)	27.80
Fat (g)	0.843
Carbohydrate (g)	13.41
Dietary fiber(g)	5.043
Calcium(mg/g)	0.79
Iron(mg/g)	3.85

This table has been extracted from M.Praveena,R.Subaratinam et al.,2021

The authors suggested that adding sapota pulp improves the sensory qualities of the milk. The selected formulation was examined for nutritional composition, physico-chemical characteristics, and microbial content based on AOAC guidelines. The conclusion asserts that sapota-flavored cotton seed milk is a best alternative to cow's milk, especially for malnourished and lactose-intolerant individuals. This research found that the new product, particularly the formulation (30%sapota), was high in energy and protein, even surpassing the nutritional content of a strawberry milkshake made with cow's milk research to explore the use of cotton seed milk in developing other food products. This research successfully developed a novel flavored milk product using cotton seed milk and sapota pulp. The findings suggest that this beverage is not only palatable, with the 30% sapota concentration being the most preferred, but also nutritionally superior to some traditional dairy-based products. This makes it a promising food option for those with specific dietary needs or a desire for plant-based alternatives. (M.Praveena,R.Subaratinam et al.,2021)

Cottonseed Milk Ice-cream

Cottonseed milk Ice-cream is a plant-based frozen dessert made using cottonseed milk as the main ingredient instead of cow’s milk. Cottonseed milk is valued for its health benefits, such as supporting brain function, improving digestion, and enhancing overall energy. During ice cream preparation, cottonseed milk is blended with natural sweeteners like sugar or jaggery, along with coconut cream, non-dairy whipping cream, or rice flour to create a smooth and creamy texture similar to regular dairy ice cream.

The mixture is then flavored, churned, and frozen. Compared to traditional dairy ice cream, cottonseed milk Ice-cream contains nearly the same protein level but less fat, making it a healthier and lighter alternative (Revathi Shanmugam *et al.,2025)*

Table:3a Physico-chemical properties of ice cream

Test	Values
pH	6.26 ± 0.02
Titratable Acidity	0.21 ± 0.01
Protein	0.21 ± 0.01
Ash	0.98± 0.02
Overrun (%)	46.6

From the study of Revathi Shanmugam et.al. 2025 tests for pH, Titratable acidity, protein, ash, overrun were performed.

Table: 3b Comparison of Cottonseed Milk Ice-cream and Dairy Ice-cream Energy Value

Parameters	Dairy based Ice-cream	Cottonseed milk Ice-cream
Moisture	53.08 ± 0.06	48.06± 0.06
Protein	3.50 ± 0.02	3.25 ± 0.02
Fat	9.08 ± 0.02	5.19 ± 0.02
Ash	2.3 ± 0.02	1.0 ± 0.02
Carbohydrate	2.3 ± 0.02	42.56 ± 0.03
Energy	223.88± 0.03	229.95 ± 0.03

From the study of Revathi Shanmugam *et al.,2025*

This research concludes that cottonseed milk Ice-cream is a healthy and suitable alternative to regular dairy ice cream. It offers good protein content, less fat, and it is completely lactose-free, making it suitable for people who are health-conscious or lactose intolerant. Even though it melts a bit faster, the use of coconut cream helps improve its texture and taste. when developed as a symbiotic Ice-cream, it support better digestion and immunity. Using cottonseed also helps reduce waste from the cotton industry, making this product both nutritious and eco-friendly. Overall, cottonseed milk Ice-cream shows great promise as a tasty, functional, and sustainable option for the future (Revathi Shanmugam *et al.,2025).*

Cottonseed Powder

Cottonseed powder is a finely milled product obtained from dehulled or defatted cottonseed kernels, rich in protein, fiber, and essential nutrient. It is produced through process such as drying, grinding, and sieving to achieve a uniform particle size. Owing to its high protein content and functional properties, it has gained attention as a potential ingredient in food formulations (Lyman *et al*., 1941 He *et al*., 2016; Lia *et al*., 2017 Wang *et al*., 2023).

Methodology for Preparation of Cottonseed Powder

Cottonseed powder can be prepared through controlled thermal and mechanical processing techniques designed to ensure uniform heating, efficient oil removal, and consistent particle size. In one approach, a thermostatically controlled cooker with continuous stirring was used to process rolled cottonseed meats weighing approximately 700 g. The seeds were mixed with a measured quantity of water to adjust the moisture level and cooked under specific temperature conditions. After heating, oil extraction was carried out using a pre-heated laboratory press maintained at 100°C for about 20 minutes. The pressed cake was then dried and finely grinded using a laboratory mill to obtain cottonseed meal powder (Lyman et al., 1941).

In another method, defatted cottonseed meal was washed with eightfold volumes of water for three successive cycles to remove soluble components. The washed material was subsequently dried using different techniques, including freeze-drying, oven-drying at 60°C, or spray-drying with inlet and outlet temperatures of 190°C and 90°C, respectively. The dried meal was ground using a hammer mill, passed through a 0.5 mm sieve, and further fractionated to produce a fine dehulled powder with a particle size below 0.30 mm (Lia et al., 2017).

Recent studies have reported similar approaches involving mechanical or solvent defatting, followed by controlled drying to maintain nutritional quality and fine milling to achieve uniform texture and improved functionality (He et al., 2016 Wang et al., 2023).

Table: 4 Independent variables and their levels.

Variables	Levels				
	I	II	III	IV	V
Acetone (A), %	60	70	80	90	100
Time of extraction (t), min	15	30	45	60	75
Liquid-solid ratio (Rlsr)	2.5:1	5:1	7.5:1	10:1	12.5:1
Number of extraction cycle	1	2	3	4	5

The above tabulation has been extracted from Varashasatankar *et.al.,*2021

Under optimized conditions 86.3% acetone concentration, 30 minutes extraction time, 10:1 LSR, and four extraction cycles the process achieved a 99.3% reduction in free gossypol and an 89.2% reduction in total gossypol, demonstrating high model reliability ($R^2 > 0.9$). The resulting low-gossypol CSKP was found to be a safe and protein-rich ingredient, making it suitable for use in nutritional supplements or animal feed. Additionally, the extracted gossypol itself holds industrial and medicinal importance due to its anti-cancer and antiviral properties, expanding the potential applications of cottonseed beyond traditional uses (He et al., 2016 Wang et al., 2023).

Cottonseed Flour

Cottonseed flour is a finely processed product obtained by milling dehulled or defatted cottonseed kernel into a uniform powder suitable for food use. It is typically produced through cleaning, drying, grinding, and sieving, often following extrusion or fermentation treatments to improve its texture and functionality. The flour is rich in high-quality plant proteins and it exhibits good emulsifying and water absorption properties, making it a valuable ingredient in bakery and snack formulations (Lia et al., 2017 He et al., 2016 Wang et al., 2023 Liu et al., 2022).

Methodology for Preparation of Cottonseed Flour

The processing of cottonseed flour involves a combination of physical, biological, and thermal treatments to obtain a fine, functional, and stable product suitable for food applications.

1. Sprouting Method

Sprouting is a simple bioprocessing technique used to improve the nutritional and functional properties of seed. Cottonseeds are first acid-delinted to remove lint, thoroughly washed, and drained to eliminate surface moisture. The seeds are then spread on trays lined with moist cloth and maintained under controlled humidity. Germination occurs within two days, after which the sprouted seeds are dried and ground into a fine flour suitable for blending with other food ingredients. (Wang et al., 2023).

2.Enzymatic or Fermentation-Based Method

In The enzymatic method, delinted and dehulled cottonseeds are sun-dried and cleaned to remove impurities such as hulls, dust, and plant residues. The cleaned kernels are ground using an electric grinder and sieved through a standard No. 20 mesh to produce a uniform kernel powder (average particle size ~0.8 mm). The powder can be subjected to microbial or enzymatic treatment under controlled temperature (30 °C) and humidity to enhance its physicochemical characteristics. After processing, the material is oven-dried and finely milled to yield smooth, homogenous cottonseed flour suitable for food formulations.

3. Extrusion Method

Extrusion cooking is an efficient thermal-mechanical process used for preparing composite flours. In this approach, defatted cottonseed powder is blended with cereal flours such as corn and rice (10–20% incorporation level) to improve texture and binding. The blend is processed through a single-screw extruder operated at increasing temperature zones: 40°C (feed section), 60°C (compression), 140°C (metering), and 170°C (die head), with a die size of approximately 3mm. The extrude product is then cooled, dried, and ground into a fine flour that exhibits enhanced solubility and dispersibility (Wang et al., 2023).

4. Mechanical and Drying Processes

Dehulled cottonseed kernels are commonly processed by mechanical grinding using hammer or burr mills, followed by sieving to obtain the desired fineness. Drying techniques such as oven-drying at 60°C, spray-drying (inlet 190°C; outlet 90°C), or freeze-drying are employed to remove moisture and improve storage stability. The resulting flour is uniform, free-flowing, and suitable for blending in bakery, snack, and beverage formulations (Lia et al., 2017; He *et al*., 2016).

5. Integrated Modern Processing

Recent studies have emphasized combining defatting, controlled drying, and fine milling to optimize flour texture and functionality. The use of pilot-scale milling and fractionation (0.3–0.5 mm sieves) helps produce a standardized particle size distribution. These integrated techniques ensure the production of high-quality cottonseed flour with improved solubility, emulsification, and mixing properties for diverse food applications (Zhang *et al*., 2021 Liu *et al*., 2022).

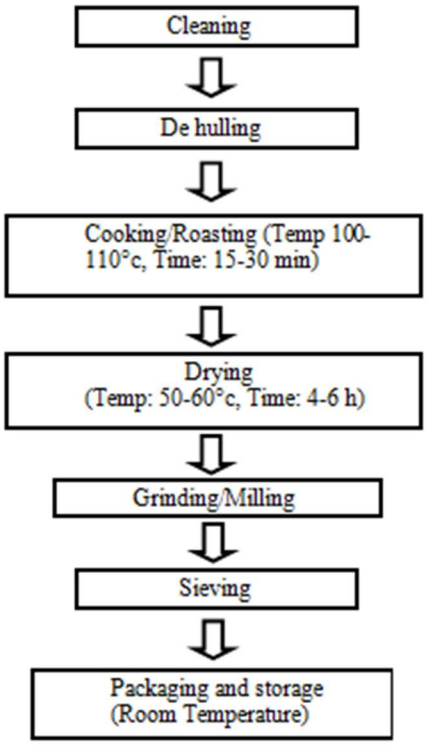

Figure .2 Flour and Powder Processing

This flowchart is extracted from z.m.zarins *et.al*.,and varsha satankar *et al.,*

Cottonseed Oil

Cottonseed Oil is one of the most valuable and widely utilized vegetable oils derived from *Gossypium* species. It is obtained as a by-product of the cotton industry, making it an important contributor to the edible oil sector and the global oilseed market. Cottonseed oil has gained increasing attention due to its high nutritional quality, oxidative stability, and bioactive components such as vitamin E (tocopherols), which exhibit strong antioxidant activity. In addition to an edible oil, it has wide industrial applications in the manufacture of soaps, cosmetics, lubricants, and biodiesel. (Tahreem Riaz *et al*,2021)

The whole cottonseed contains approximately 15–20% oil and 30–38% kernel, depending on seed variety, growth conditions, and processing method. Refined oil that is low in gossypol a naturally occurring toxic polyphenolic compound in cotton plants is pale yellow in color, has high vitamin E content, and possesses excellent oxidative stability, making it suitable for direct consumption as cooking oil or for the production of vanaspati (hydrogenated vegetable fat) (Savanam Chandra Sekhar and Bhaskara Rao, V.K 2011).

The superior keeping quality of Cottonseed oil is comparable to that of other edible oils such as sunflower and soybean oil (Alderks, 1948). The United States were the first country to commercialize bottled cottonseed oil, labeling it in multiple European languages to enhance its consumer appeal it as an alternative to the olive oil.

The physicochemical characteristics of cottonseed oil, including acid value, iodine value, saponification value, peroxide value, refractive index, and specific gravity, determine its quality and usability for both food and industrial purposes. These parameters reflect its stability, purity, and degree of unsaturation. Cottonseed oil is recognized for having a balanced fatty acid profile, providing a good mix of saturated, mono unsaturated, and poly unsaturated fatty acids However, the presence of gossypol and other polyphenolic compounds, along with the potential use of toxic organic solvents during extraction, restricts its direct use as edible oil. Hence, refining and detoxification are crucial steps in ensuring its safety for human consumption (Manoj Kumar *et al.,* 2023).

Nutritional Value

Cottonseed oil, like all plant derived oils, is cholesterol free and it is rich in essential fatty acids, particularly linoleic acid (18:2), which accounts for a significant portion of total fatty acid content. Linoleic acid is an omega-6 polyunsaturated fatty acid known to regulate blood cholesterol levels and promote cardiovascular health .The oil contains nearly three times more unsaturated fatty acid than saturated fatty acids, which aligns with dietary recommendations for reducing saturated fat intake. Owing to the proportion of stearic, palmitic, and oleic acids, Cottonseed oil is often described as “naturally hydrogenated”, possessing inherent oxidative stability suitable for deep frying without the need for chemical hydrogenation, a process that can otherwise generates trans fatty acids. When partially hydrogenated to an iodine value (IV) of approximately 80, the fatty acid composition typically changes to 50% monounsaturated, 21% polyunsaturated, and 29% saturated fatty acids, all of which are within recommended health limits. (Dinesh K. Agarwal *et.al.,*2003)

Table.5 Nutritional Value of Cottonseed Oil

FATTY ACID	COTTONSEED COOKING OIL
Myristic (14:0)	0.8
Palmitic (16:0)	24.4
Palmitoleic (16:1)	0.4
Stearic (18:0)	2.2
Oleic (18: 1)	17.2
Linoleic (18:2)	55.0
Linolenic (18:3)	0.3

SUMMARY	
Saturates	27%
Monounsaturates	18%
Polyunsaturates	55%

From the study of Dinesh K. Agarwal *et.al,(*2003) Cottonseed oil is a notable source of tocopherols, primarily γ- and α-tocopherols, which act as potent antioxidants that enhance the oil's shelf life and offer protective health benefits by scavenging free radicals.

Composition of Cottonseed Oil

Gas Chromatography Mass Spectrometry analysis of cotton seed oil identified ten fatty acid methyl esters. The major components were linoleic acid (30.22%), palmitic acid (25.32%), vaccenic acid (22.27%), oleic acid (4.S2%), and stearic acid (4.1S%). Minor components included 7,10-hexadecadienoic acid (0.73%), myristic acid (0.53%), stearolic acid (0.24%), 7-hexadecenoic acid (0.1S%), and tridecanoic acid (0.18%). Linoleic acid, a polyunsaturated fatty acid, helps prevent food spoilage. Vaccenic acid has shown tumor-suppressing properties,While oleic acid contributes to anti-inflammatory, bactericidal, and anticancer effects. (Zubair MF *et al.,* 2021)

Extraction process

In the extraction of cottonseed oil, high-quality oil with natural colour and flavour can be obtained,but the procedure often demands a longer duration for processing and refining. Solvent method and Mechanical method is a commonly used method of oil extraction at laboratory scale for many studies. Other non-conventional methods of oil extraction such as Microwave Assisted Extraction, Ultrasound Assisted Extraction, Supercritical Fluid Extraction, and Enzyme Assisted Extraction at optimum conditions also give better oil yield than conventional method within a short period of time (Al Khawli et al. 2019; Putnik *et al*. 2018, 2017).

Solvent extraction relies on the solvent's ability to dissolve and extract oil from oilseeds. Common solvents include n-hexane, ethanol, methanol, chloroform, and petroleum ether. Factors such as particle size, solvent-to-solid ratio, temperature, and extraction time significantly influence yield. Smaller particle sizes (0.6 mm) and higher temperatures (around 318 °C) enhance oil solubility and diffusion, resulting in higher yields. Studies have shown that ethanol can serve as an effective and safer alternative to n-hexane for Cottonseed oil extraction. Using the Soxhlet method with n-hexane at 70 °C for 5 h, oil yields from different cottonseed varieties ranged from 12–14.55%. (Shah 2017)

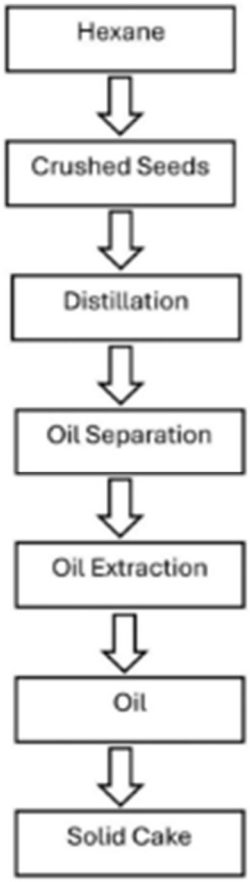

Figure: 3a Solvent Extraction

From the study of Tahreem Riaz *et al.,*2021.

Mechanical Extraction, clean and dry cottonseeds are directly processed using screw or hydraulic presses. These physical methods extract oil without the use of chemical solvents, producing high-quality oil that retains its natural colour, aroma, flavour, and nutrients. Unlike solvent-based methods that involve multiple refining steps and may reduce nutritional value, yields of pure oil free from additives and toxic residues. (Kristoferson and Bokalders 1986; Nde and Anuanwen 2020; Pliego-Arreaga *et al*. 2013)

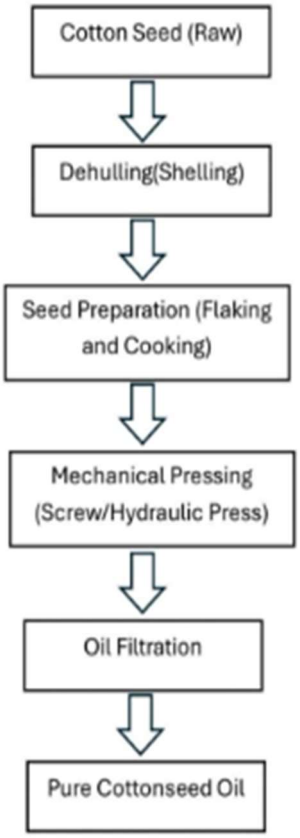

Figure: 3b Mechanical Extraction

From the study of Manoj Kumar *et al*., 2023).

Enzyme-assisted extraction utilizes enzymes such as Phytezyme and Natuzyme to degrade seed cell walls, enhancing oil recovery and reducing free fatty acid formation. Modern techniques like microwave-assisted extraction, supercritical CO_2 extraction (SC-CO_2), Subcritical water extraction, and Aqueous/ethanol extraction offer higher efficiency, reduced solvent use, and improved oxidative stability. MAE provides rapid heating and cell disruption, achieving yields up to 38%, while SC-CO_2 extraction yields over 40% oil with minimal gossypol content under mild conditions. Subcritical water extraction, and Aqueous/ethanol extraction are recognized as green alternatives, producing high-quality oil and valuable bioactive compounds without toxic solvents. (Manoj Kumar *et al*., 2023).

Hence, this research states that extraction of Cottonseed oil with less gossypol content and without use of toxic chemicals is an important task for research. (Manoj Kumar *et al*., 2023).

Limitation and Future Scope

In spite of being one of the world's major crops, cottonseed remains an underexplored and undervalued resource in the field of Food Science and Technology. While it holds immense potential as a nutritious and sustainable ingredient, research on its application in food products has been minimal over the years. To date, only one research paper has been published on cottonseed flavoured milk and cottonseed ice cream, and about three studies have investigated cottonseed powder and its possible uses in food formulations. This clearly reflects a significant gap in scientific exploration and product development on cottonseed. Future research should emphasize innovative processing methods, flavour enhancement, and gossypol detoxification technique to ensure product safety and consumer acceptability. Furthermore, extensive studies on the nutritional profiling, sensory evaluation, and industrial-scale feasibility of cottonseed-based foods are essential to transform this underutilized seed into a valuable functional ingredient for future food innovations.

Conclusion

This review demonstrates that cottonseed, a by-product of the cotton industry, holds strong potential as a sustainable and nutritious resource for food applications. Through effective detoxification and processing, cottonseed can be transformed into safe, protein-rich products such as milk, flavored beverages, ice cream, powder, flour and oil. These plant-based alternatives offer excellent nutritional value, good sensory properties, and suitability for lactose-intolerant and health-conscious consumers. Advancements in processing technologies have also enabled significant gossypol reduction, ensuring safety and quality. Overall, cottonseed-based products present a promising opportunity to enhance nutrition, promote sustainability, and add economic value to the cotton industry.

References

1.Al Khawli F, Pateiro M, Domínguez R, Lorenzo JM, Gullón P, Kousoulaki K, Barba FJ (2019). Innovative green technologies of intensification for valorization of seafood and their by-products. MDPI Journal.17(12),689.

2. Revathi Shanmugam, Lavanya M, Dakshina Priya B, Rishi K (2025) Development of Plant Based Ice cream from Cottonseed Milk. International Research Journal of Engineering and Technology.12 (5), 2395-0072.

3. J Vijaya Chandiya, S Anhuradha, K Jayabalan (2012) Production of fortified health drink using cotton seed milk and kale leaves. IJFANS International Journal of food and nutritional sciences14 (5), 294-305.

4. Manoj Kumar (2019) Paruthi Paal, a nutrient-rich healthy drink from cottonseed: an Indian delicacy. Journal of Ethnic Foods. 6,32.

5. Pidathala sahitya, Kishore Srinivasan R, Aswinth K, Subikshon B (2024) Formulation of symbiotic ice cream from cottonseed milk. International Journal of Advance Research and Innovative Ideas in Education. 10 (2), 4472-4481.

6. Ana Leahu, Sorina Ropciuc and Cristina Ghinea (2022) Plant-Based Milks: Alternatives to the Manufacture and Characterization of Ice Cream. MDPI Journal. 15(19),10840.

7. M. Praveena1, R. Subaratinam 2(2021) Formulation and evaluation of sapota flavored cotton seed milk. International Journal of Multidisciplinary Research in Arts, Science & Commerce.1(2), 20-28.

8. Siyong You,Yuchen Ma, Bowen Yan, Wenhui Pei, Qiming Wu, Chao Ding and Coaxing Huang (2022) The promotion mechanism of prebiotics for probiotics: A review. Frontiers in Nutrition. 9,1000517.

9. Devesh K Saxena, S. K. Sharma and S. S. Sambi (2011) Comparative extraction of cottonseed oil by n-hexane and ethanol. ARPN Journal of Engineering and Applied Sciences.6(1), 84-89.

10. Savanam Chandra Sekharl and Bhaskara Rao, V K (2011) Cottonseed Oil as Health Oil. Pertanika Journal of tropical agricultural science. 34(1), 17-24.

11. Manoj Kumar, Baohong Zhang, Jayashree Potkule, Kanika Sharma1, Radha, Christophe Han, Vijay Sheri, Deepak Chandran, Sangram Dhumal, Abhijit Dey, Nadeem Rais, Marisennayya Senapathy, Suman Natta, Sabareeshwari Viswanathan, Pran Mohankumar, José M. Lorenzo (2023) Cottonseed Oil: Extraction, Characterization, Health Benefits, Safety Profile, and Application. Springer Journal. 16,266-280.

12. Dinesh K. Agarwal, Phundan Singh, Mukta Chakrabarty, A J Shaikh, S G Gayal (2003) Cottonseed oil quality, utilization and processing. Central Institute for Cotton Research Nagpur 25,1-16.

13. Tahreem Riaz, Muhammad Waheed Iqbal, Shahid Mahmood, Iqra Yasmin, Ali Ahmad Leghari, Abdur Rehman, Anam Mushtaq, Khubaib Ali, Muhammad Azam & Muhammad Bilal (2021) Cottonseed oil: A review of extraction techniques, physicochemical, functional, and nutritional properties. Taylor and Francis 63(9) 1219-1237.

14. Varsha Satankar Mohan Singh, Vellaichamy Mageshwaran, Durwesh Jhodkar, Sushil Changan, Manoj Kumar and Mohamed Mekhemar (2021) Cottonseed Kernel Powder as a Natural Health Supplement: An Approach to Reduce the Gossypol Content and Maximize the Nutritional Benefit. MDPI Journal.11,3901,1-16.

15. MariliF.Zubair1, Olalekan Sulyman Ibrahim1, Olubunmi Atolani, and Abdulmumeen Amao Hamid2(2021) Chemical Composition and Nutritional Characterization of Cotton Seed as Potential Feed Supplement. Jouenal od the Turkish Chemical Society Chemistry. 8(4), 977-982.

16. Roscoe C Clark (1932) Cottonseed Products Industry. Journal of Accountancy.54(3), 170-191.

17. Ping Song1, Kai Yuan, Xiao-Jun Ji, Lu-Jing Ren, Sen Zhang, Jian-Ping Wen1 and He Huang (2018) Effects of Cotton Seed Powder as the Seed Medium Nitrogen Source on the Morphology and Pneumocandin B_oYield of Glarea lozoyensis.frontiers in Microbiology. 9,2352.

18.H L E Vix, P H Eaves, H K Gardner J r, and M G Lambou (1971) Degossypolized Cottonseed Flour-The Liquid Cyclone Process. Journal of the American Oil Chemists Society. (10), 611-615.

19. Varsha Satankar, Durwesh Jhodkar, Mohan Singh, Manoj Kumar, Vellaichamy Mageshwaran, Sivasubramanian Palanisamy, Nadir Ayrilmis,Tabrej Khan (2024) Two-step process for gossypol reduction and protein enhancement in cottonseed kernel powder Research Gate. 15(6), 9475-9488.

20. S P Clark, G W Baker, S W Matlock and D Mulsow (1978) Cottonseed Flour Production: Economic Evaluation. Journal of the American Oil Chemists Society 55,690-694.

21. FU Wazir, IU Wazir, M Javeed, Fida Muhammad, Msaeed Jehanzeb Khan and S Hamayun Shah (2006) Morphological changes induced by cottonseed flour in rat testes. 22,105-109

22. Z M Zarins and J P Cherry (1981) Storage Proteins of Glandless Cottonseed Flour. Journal of Food Science. 65(4),359-362.

23. K M Decossas, R S Kadan, J J Spadaro, G M Ziegler Jr and D W Freeman (1982) Edible Cottonseed Flour by Air Classification of Glanded Seed: Cost Analysis. Journal of the American Oil Chemists Society 59,488-494.

24. J Cabrera, L E Zapata, T S de buckle, I Ben-Gera, A M de Sandoval and I shomer (1979) Production of textured Vegetable Protein from Cottonseed Flours. Journal of Food Science. 44(3), 826-829.

25.Shah SN (2017) FTIR characterization and physicochemical evaluation of cottonseed oil. Pakistan J Anal Environ Chem 18(1),46–53.