Technological, Processing and Nutritional Aspects of Chickpea (Cicer arietinum)

Asia Arooj¹, Sidra Faiz², Javed Anwar Shah², Amina Ramzan¹, Muhammad Ihsan³, Muhammad Saleem¹*

¹Department of Botany, University of Agriculture Faisalabad, Pakistan
²Plant Pathology Research Institute, Faisalabad, Pakistan
³Department of Botany, University of the Punjab, Lahore, Pakistan

DOI: 10.36348/sjpm.2021.v06i04.006 | Received: 16.03.2021 | Accepted: 24.04.2021 | Published: 29.04.2021

*Corresponding author: Muhammad Saleem

Abstract

Chickpea adds significant amount of nitrogen to soil and organic matter to improve the soil fertility and health aspects. Chickpea is grown in semi-arid areas, consider as drought tolerant and many cultivars with various levels of tolerance to drought have been produced. Worldwide chickpea in 2018 was 17.19 million tones which account for 18.63% of total pulse production. In chickpea, the chief phytochemicals comprise of flavonoids, phenolic acids, lignin, stilbenes and carotenoids. In chickpea, phytochemical are phenolic compounds, specifically 5-deoxyiso flavonoids and have important role in providing defensive action against pathogens and also help in nitrogen fixation by acting as chemical signal. As compared to other pulse protein like pea and soybean protein chickpea protein has highest thermal expansion value, stability and forming capacity compared to other pulse protein like pea and soybean protein chickpea protein has highest thermal expansion value, stability and forming capacity. Chickpea adds significant amount of nitrogen to soil and organic matter to improve the soil fertility and health aspects. Chickpea is grown in semi-arid areas, consider as drought tolerant and many cultivars with various levels of tolerance to drought have been produced. Worldwide chickpea in 2018 was 17.19 million tones which account for 18.63% of total pulse production. In chickpea, the chief phytochemicals comprise of flavonoids, phenolic acids, lignin, stilbenes and carotenoids. In chickpea, phytochemical are phenolic compounds, specifically 5-deoxyiso flavonoids and have important role in providing defensive action against pathogens and also help in nitrogen fixation by acting as chemical signal. As compared to other pulse protein like pea and soybean protein chickpea protein has highest thermal expansion value, stability and forming capacity. Chickpea consider as a suitable vehicle for developing the replacement beverage because it is a rich source of nutrition. Individual suffering from lactose intolerance plant based beverage are beneficial for stability and forming capacity.

Keywords: Chickpea, applications, bioactive compounds, technological processes.

INTRODUCTION

Throughout the world pulses are widely cultivated crops since ancient time. They are rich source of micronutrients, dietary fiber, and protein and have numerous health benefits. For maintainable future pulses are described as nutritional seeds and the year 2016 was professed as the International year of pulses. For their protein requirement vegetarian people dependent on pulses. In developing countries, pulses in combination with cereals are extensively consumed as an essential diet [1, 2]. Vegetarian peoples who cannot afford animal protein chickpea is inexpensive and significant source of protein [3]. Additionally, chickpea is a good source of unsaturated fatty acid, minerals, and β-carotene. Important role in sustaining the soil fertility by fixing the nitrogen at the rate of up to 140 Kg/ha/year Chickpea relatively required low amount of nitrogen as it derives 70 percent of nitrogen of its N through symbiotic N2 fixation and benefits other cereal crops as well. For dry land crop production chickpea was found to be superior due to an adaptive root distribution. Chickpea and pea under drought stress dry matter yield reduced by 36.4, 23.9 and 14.5%, respectively [4, 5].

Production of Chickpea

In the world, India is the largest country in chickpea production with a share of about 66.19% and contributes 86.03% to Asia’s total chickpea production. In the world after pulse crop, chickpea is the second most widely cultivated crop [6]. In the world total cultivated area under pulse crop in the year 2018 was 95.76 million hectares out of which 17.81 million hectares are covered under chickpea cultivation. Worldwide chickpea in 2018 was 17.19 million tones which account for 18.63% of total pulse production. Total global pulse production in India 27.53% and in Asia 59.67% [7, 8, 9].

Bioactive compounds in Chickpea

The presence of bioactive components in chickpea has a several health benefits. In chickpea the chief phytochemicals comprise of flavonoids, phenolic acids, lignin, stablesness and carotenoids. Chickpea variety as compared to Kabuli antioxidant compounds...
in greater amount. Against the damage caused by reactive oxygen species in living species that are formed as a result of successive single electron reduction of molecular oxygen these antioxidant compounds are accountable for providing the protection system[10].

In chickpea, majority of phenolic and flavonoids are present in seed coat in concentrated form and levels of these as flavonoid, total phenolic, and antioxidant activity respectively lower [11]. As compared to other phenolic acids and flavonoids chlorogenic and quercetin are found higher concentration. Carotenoids mainly xanthophyll cryptoxanthin and beta carotene all these compound extract from chickpea seeds. Carotenoids are of great significance as they increase the bio-availability of iron in human body by acting as promoters of iron absorption. Canthaxanthin is found to have anti-cancerous and anti-tumor properties [12, 13].

Technological Aspects of Chickpea for Traditional and Novel Food Uses

In development of chickpea based bread these characteristic of chickpea protein plays a role. Its imparts high specific volume to the bread apart improving the nutritional characteristic. Adding of chickpea flour in free from gluten batter resulted in an increase in storage of modulus and decrease in cohesiveness was observed during chickpea bread storage [14, 15].
For making bread, adding chickpea flour to the wheat in dough mixture, affects rheological properties of the dough. Chickpea wheat flour dough indicated that with water absorption capacity of the dough was found to increase with increase in the level of chickpea flour whereas there was decrease in dough development and stability. The amount of gluten decreased with the increase in the ratio of chickpea flour resulting in weaker dough. Observed from extenso-graph incorporation of chickpea flour resulted in increased dough extensibility. Partial substitution of wheat flour by chickpea flour (30%) in bread making resulted in enhanced rheological belongings [16, 17].

For preparation of various traditional food products like thin pancake, deep fat fried spherical droplets, and steamed savory cake dehisced chickpea flour is used in the form of batter in water. For making thick chickpea batter appropriate amount of water is added and continuously stirring. To impart taste different flavors are added to prepare fragilities obtained from use of batter. Rheological properties of the chickpea four suspension and additives effect on its properties studied by reported and researchers elsewhere. Decrease with an increase in shear rate superficial viscosity of 40 percent flour of chickpea suspension [18, 19, 20].

In case of chickpea protein isolation this shear thinning behavior has also been studied. This phenomenon takes place due to the shear forces resulting in breakdown of agglomerated particles. Chickpea suspension categorized as non-Newtonian fluid. In the preparation of traditional fried food products addition of salt in the batter, provides better flow properties. This is due to the plasticization effect of the salt [21, 22].

The salt soluble fraction of chickpea protein, which is globulin, gets solubilized to greater extent with increase in salt concentration thus decreasing the viscosity by adding it to the continuous phase. To get flour of chickpea suspension droplets are deep fried in oil. Simultaneous transfer of heat and mass is a frying process. During this process oil is a medium for transfer of heart to food surface convection and towards the center by conduction, migration of fat into food, moisture migrate out through cavities [23, 24, 25, 26].

![Image](image.png)

**Fig-3: Shows the nutritional importance of chickpea with combination of remilled semolina**

During frying quality of final product affected by the batter concentration and in batter quality of product in term of firmness, oil less uptake, uniformity and oily mouth feel, it had been 40-42% concentration observed. Transferring the fried boondi into hot sugar syrup boondi for this purpose additional processed into spiced or sweet boondi needed reserved for some time for sugar impregnation. Then into small balls, commonly called as Ladoo from the sweetened boondi. As a prasad served on religious events. In India besan ladoo, and boondi lado are commonly offered as festive treats. On the other hand, spiced boondi is also commonly used to serve large meal after the addition into the crud and is known as boondi raita. Another name of roasted chickpea is sattu, in the summer consumed as a drink and it cause cooling effect on body of human [27, 28].

By mixing with milk it also consumed in slurry form and useful for those people which suffering from gastrointestinal ulcer. Due to low cost high nutritional value and several health benefits it is popular in people. It has different formulation that consists of pulses and cereals. Flours of germinated pulse and cereal incorporated to increase the nutritional properties of sattu. To sattu drink lime juice, spices, salt and sugar flavors are added [29, 30].

Thermal and physical properties of roasted chickpea flour found to be affected by the particle size of flour and moisture content. Flow ability of roasted chickpea flour was reduced, bulk density and true density increase at higher moisture content. With increase in moisture content thermal conductivity increase. With decrease in particle size specific heat
increase significantly. With increase in moisture content particle size reduced, thermal diffusivity of roasted chickpea flour was found to increase [31, 32, 33].

To improve nutritional value chickpea flour is used in different food items like pasta, dairy products like yoghurt, bread and biscuit. Ready to eat snack food it is also used mainly the extruded products. Durum wheat is used in preparation of widely consumed food products. Significant decrease in glycemic index and increase in protein, mineral content and fat with addition of 25% chickpea flour in pasta [34-38].

In another observation pasta reduced the cooking time water absorption and increased adhesiveness with addition of chickpea flour. With increase chickpea flour level, the glycemic index decrease. De-hulled chickpea flour enhances the cooking quality and the utilization of whole chickpea flour in pasta decrease the cooking quality. Differential scanning calorimetric results of composite pasta and semolina pasta made of chickpea flour and semolina showed that degree of starch gelatinization was lower in chickpea as compared to semolina incorporated pasta. This is mainly due to the protecting influence exerted by the matrix formed by non-starch polysaccharides, protein, and fat present in in flour of chickpea [39-42].

The translational stage of weaning children leads to Protein Energy Malnutrition (PEM) if mother’s milk is shifted to nutritionally imbalanced food. Effective weaning foods are required to prevent the childhood malnutrition that is nutritious and inexpensive at the same time. The whole chickpea grain utilization for the production of infant formula has already been investigated. Chickpea germination followed by drying, dulling, and boiling can be suitable technique for preparing infant follow on formula with vitamin and mineral fortification [43-49].

Skimmed milk powder and sugar mixed with extruded flour of chickpea and maize can also be utilized as weaning food. It is found to have increased in-vitro digestibility of protein and starch. Roller dried or popped malted barley and chickpea have also been used in the improvement of weaning foods [50]. Due to shift towards veganism increase in demand of plant base milk. For cow’s milk legumes are consider as a potential substitute. Plant based soy milk beverage available in the marketplace is the most common [51-52].

CONCLUSION

As compared to other substitute plant based milk using coconut and chickpea is a good nutritional profile, especially high calcium and protein level. In term of nutritional quality and sensory profile 30% coconut extract and 70% chickpea extract gave batter results. For substituting cow milk and soy milk fresh and fermented chickpea beverage also has potential. In the development of stirred bio yoghurt chickpea flour utilized as prebiotic and thickening agent. Combination of chickpea flour in stirred bio yoghurt resulted that viscosity increased and antioxidant activity improved.

REFERENCES

1. Aguilar, N., Albanell, E., Miñarro, B., & Capellas, M. (2015). Chickpea and tiger nut flours as alternatives to emulsifier and shortening in gluten-free bread. LWT-Food science and Technology, 62(1), 225-232.
2. Ali, S., Singh, B., & Sharma, S. (2017). Development of high- quality weaning food based on maize and chickpea by twin- screw extrusion process for low- income populations. Journal of Food Process Engineering, 40(3), e12500.
3. Altaf, U., Hussain, S. Z., Qadri, T., Iftikhar, F., Naseer, B., & Rather, A. H. (2020). Investigation on mild extrusion cooking for development of snacks using rice and chickpea flour blends. Journal of Food Science and Technology, 1-13.
4. Aoki, T., Akashi, T., & Ayabe, S. I. (2000). Flavonoids of leguminous plants: structure, biological activity, and biosynthesis. Journal of Plant Research, 113(4), 475.
5. Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., De Onis, M., Ezzati, M., ... & Maternal and Child Undernutrition Study Group. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. The lancet, 371(9608), 243-260.
6. Boye, J., Zare, F., & Pletch, A. (2010). Pulse proteins: Processing, characterization, functional properties and applications in food and feed. Food research international, 43(2), 414-431.
7. Budžaki, S., & Šeruga, B. (2005). Determination of convective heat transfer coefficient during frying of potato dough. Journal of Food Engineering, 66(3), 307-314.
8. Shahid, A., Ali, S., Zahra, T., Raza, M., Shahid, A., Saeed, M. U., & Javaid, F. (2020). Influence of Microbes in Progression of Cancer and DNA Damaging Effects. Haya: The Saudi Journal of Life Sciences.
9. Iftikhar, A., Shahid, A., Shah, S. S., Ali, S., Raza, M., Ali, E., & Umbreen, S. Antimicrobial Activities of Selected Medicinal Plant with Potential Role of Chemical Compounds.
10. Naeem, M., Hayat, M., Qamar, S. A., Mehmood, T., Munir, A., Ahmad, G., ... & Mehmood, F. (2019). Risk factors, genetic mutations and prevention of breast cancer. Int. J. Biosci, 14(4), 492-496.
11. Shafiq, S., Adeel, M., Raza, H., Iqbal, R., Ahmad, Z., Naeem, M., ... & Azmi, U. R. (2019). Effects of Foliar Application of Selenium in Maize (Zea Mays L.) under Cadmium Toxicity. In Biological
Based Bioengineering Strategies. In 6th International Conference on—Sustainable Agriculture in Changing Climate: Strategies and Management (Vol. 261).

23. Rafeeq, H., Arshad, M. A., Amjad, S. F., Ullah, M. H., Muhammad, H., Imran, R. K., ... & Ajmal, H. Effect of Nickel on Different Physiological Parameters of Raphanus Sativus.

24. Ghani U, Naeem M, Bukhari SS, Yar G, Tariq I, Siddique S, Nawaz HA, Pal ZA, Nasim F, Bukhari SA. (2019). Prevalence and Risk Factors Associated with Hepatitis B and Hepatitis C and their Correlation with Inflammatory Markers among Southern Region of Punjab. Prevalence and Risk Factors associated with Hepatitis B and Hepatitis C and their Correlation with Inflammatory Markers among Southern Region of Punjab. Biological Forum - An International Journal, 11(2), 136-143.

25. Ghani U, Naeem M. (2019). Safety assessment of immune mediated reaction to Novel Food Proteins. 6th International Conference on “Sustainable Agriculture in Changing Climate: Strategies and Management. 282.

26. Haile, M., & Kang, W. H. (2019). The role of microbes in coffee fermentation and their impact on coffee quality. Journal of Food Quality, 2019.

27. Cho, W. Y., Kim, D. H., Lee, H. J., Yeon, S. J., & Lee, C. H. (2020). Journal of Food Quality Evaluation of Effect of Extraction Solvent on Selected Properties of Olive Leaf Extract. Journal of Food Quality, 2020.

28. Munir, A., Ali, J., Naeem, M. (2020) Improvement of Fruit and Vegetable quality through Postharvest Biology. 1st international Conference on Sustainable Agriculture: Food Security under Changing Climate Scenarios.61

29. Adeel, M., Shafiq, S., Naeem, M., Baber, I. A., Ali, M., Iqbal, R. (2019). Interactive effect of ascorbic acid and melatonin on morphophyiological and ionic attributes of Okra challenged with salt stress. 1st international Conference on Sustainable Agriculture: Food Security under Changing Climate Scenarios.

30. Sajid, S. N., Rubab, A., Azhar, N., Naeem, M. (2019). Global Environmental Risks Factors and Non Communicable Diseases. International Conference on Innovative Biological and Public Health Research.

31. Naeem, M., Munir, A., Siddiqi, S. H. (2019). Development and use of Molecular Markers in Health Care. International Conference on Innovative Biological and Public Health Research.

32. Munir, A., Naeem, M. (2019). Zika Virus Vaccine Development and New Challenges. International Conference on Innovative Biological and Public Health Research. 47

33. Ali, J., Naeem, M. (2019). Emergence of Mosquito Borne Viral diseases in Pakistan. International
Conference on Innovative Biological and Public Health Research.47
34. Iqra, Naeem, M., Munir, A. (2019). Novel Approach towards vaccine development through Nanoparticles. International Conference on Innovative Biological and Public Health Research.44
35. Naeem, M., Azmi, U. R., Irfan, M., Ghani, U. (2019). Reducing Risks to Food security from climate change. First International Conference on Sustainable Agriculture: Food Security under Changing Climate Scenarios.79
36. Azmi, U. R., Qureshi, H. A., Akram, M. W., Naeem, M., Ali, A. (2019). Potassium influence crop yield and quality production. First International Conference on Sustainable Agriculture: Food Security under Changing Climate Scenarios.73
37. Naeem, M. (2019). Principles of Biochemistry & Biological Sciences. Nishtar Publications.464
38. Sofi, S. A., Muzaffar, K., Ashraf, S., Gupta, I., & Mir, S. A. (2020). Chickpea. In Pulses. Springer, Cham. 55-76.
39. Pult, P., Ghosh, R., Tolani, P., Tarafdar, A., Chitikineni, A., Bajaj, P., ... & Varshney, R. K. (2020). Molecular and Physiological Alterations in Chickpea under Elevated CO2 Concentrations. Plant and Cell Physiology, 61(8), 1449-1463.
40. Rani, A., Devi, P., Jha, U. C., Sharma, K. D., Siddique, K. H., & Nayyar, H. (2020). Developing climate-resilient chickpea involving physiological and molecular approaches with a focus on temperature and drought stresses. Frontiers in plant science, 10, 1759.
41. Pourdarbani, R., Sabzi, S., Kalantari, D., Hernández-Hernández, J. L., & Arribas, J. I. (2020). A computer vision system based on majority-voting ensemble neural network for the automatic classification of three chickpea varieties. Foods, 9(2), 113.
42. Kumar, P., & Naik, M. (2020). Biotic symbiosis and plant growth regulators as a strategy against cadmium and lead stress in chickpea. Plant Archives, 20(2), 2495-2500.
43. Korbu, L., Tafes, B., Kassa, G., Mola, T., & Fikre, A. (2020). Unlocking the genetic potential of chickpea through improved crop management practices in Ethiopia. A review. Agronomy for Sustainable Development, 40(2), 1-20.
44. Abbas, E., Osman, A., & Sitohy, M. (2020). Biochemical control of Alternaria tenuissima infecting post-harvest fig fruit by chickpea vicilin. Journal of the Science of Food and Agriculture, 100(7), 2889-2897.
45. Soe, K. M., Htwe, A. Z., Moe, K., Tomomi, A., & Yamakawa, T. (2020). Diversity and effectivity of indigenous Mesorhizobium strains for chickpea (Cicer arietinum L.) in Myanmar. Agronomy, 10(2), 287.
46. Xing, Q., Dekker, S., Kyriakopoulou, K., Boom, R. M., Smid, E. J., & Schutyser, M. A. (2020). Enhanced nutritional value of chickpea protein concentrate by dry separation and solid state fermentation. Innovative Food Science & Emerging Technologies, 59, 102269.
47. Ullah, S., Khan, J., Hayat, K., Abdel fattah Elateeq, A., Salam, U., Yu, B., ... & Tang, Z. H. (2020). Comparative study of growth, cadmium accumulation and tolerance of three chickpea (Cicer arietinum L.) cultivars. Plants, 9(3), 310.
48. Glusac, J., Isaschar-Ovdat, S., & Fishman, A. (2020). Transglutaminase modifies the physical stability and digestibility of chickpea protein-stabilized oil-in-water emulsions. Food chemistry, 315, 126301.
49. El-Beltagi, H. S., Mohamed, H. I., & Sofy, M. R. (2020). Role of ascorbic acid, glutathione and proline applied as singly or in sequence combination in improving chickpea plant through physiological change and antioxidant defense under different levels of irrigation intervals. Molecules, 25(7), 1702.
50. Yousef, F., Shafique, F., Ali, Q., & Malik, A. (2020). Effects of salt stress on the growth traits of chickpea (Cicer arietinum L.) and pea (Pisum sativum L.) seedlings. Biol Clin Sci Res J, 29.
51. Pushpavalli, R., Berger, J. D., Turner, N. C., Siddique, K. H., Colmer, T. D., & Vadez, V. (2020). Cross- tolerance for drought, heat and salinity stresses in chickpea (Cicer arietinum L.). Journal of Agronomy and Crop Science, 206(3), 405-419.