

Empower Teenagers and Farmers about Food Preservation and Processing Technique

Swarnima Singh¹ and Sunita Mishra²

¹M.Sc Student, Department of Food and Nutrition, Babasaheb Bhimrao Ambedkar University, Lucknow.

²Corresponding Author, Professor, Department of Food and Nutrition, Babasaheb Bhimrao Ambedkar University, Lucknow.

To Cite this Article

Swarnima Singh and Sunita Mishra, “Empower Teenagers and Farmers about Food Preservation and Processing Technique” *Journal of Science and Technology*, Vol. 08, Issue 07, -July 2023, pp25-38

Article Info

Received: 26-06-2023

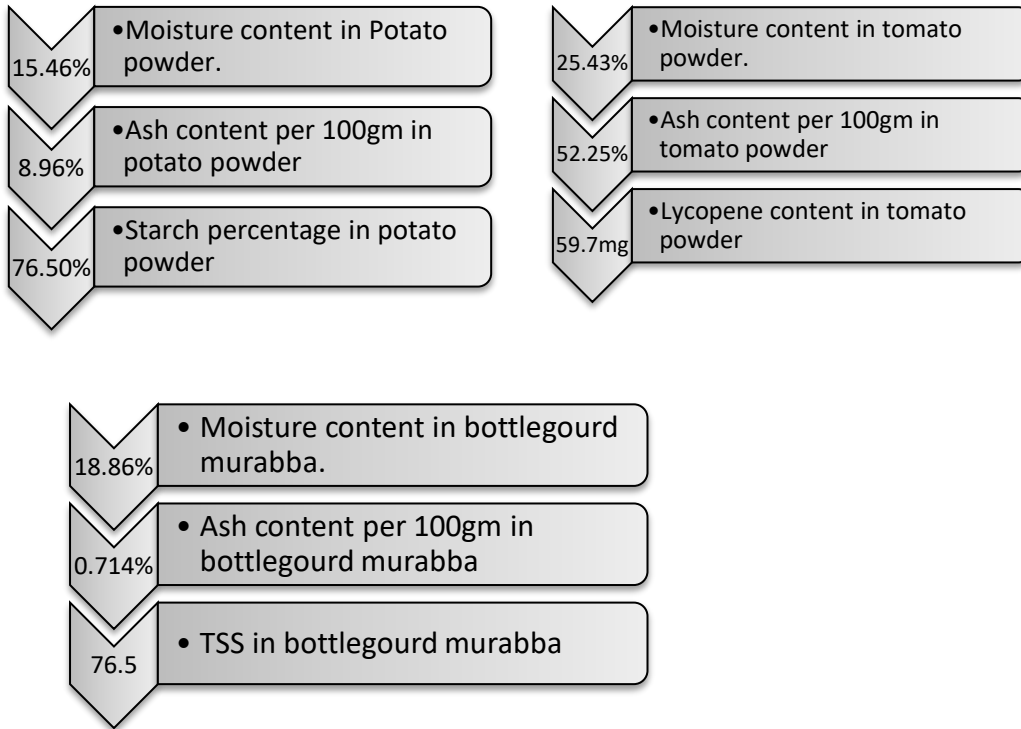
Revised: 28-06-2023

Accepted: 09-07-2023

Published: 13-07-2023

Abstract

This study focuses on food preservation techniques for highly perishable vegetables, specifically potatoes, tomatoes, and bottle gourds. The research aims to conduct a nutritional analysis of the processed products, including potato powder, tomato powder, and bottle gourd murabba. Additionally, sensory analysis will be performed to evaluate the quality and acceptability of the preserved items. Furthermore, a farmer demonstration will be conducted to educate and showcase the preservation techniques to farmers. To assess the nutritional value of the processed products, a detailed nutritional analysis will be carried out. This analysis will include determining the levels of moisture content, ash content, pH, lycopene content, starch, and TSS of the potato powder, tomato powder, and bottle gourd murabba. Also microbial analysis should be done to study the shelf life of product. The findings will provide valuable insights into the nutritional content, potential health benefits and shelf life of these preserved products. Sensory analysis will be conducted to evaluate the sensory attributes of the preserved items. untrained panelists and consumers will participate in the evaluation, assessing factors such as taste, texture, aroma, and overall acceptability. Furthermore, a farmer demonstration will be organized to educate farmers about the preservation techniques. The demonstration will involve step-by-step training on preserving potatoes, tomatoes, and bottle gourds using the sun drying method. Farmers will learn the proper procedures for slicing, drying, and preserving the vegetables, as well as the various applications and benefits of the preserved product. Overall, this research has the potential to enhance food security, reduce waste, and promote sustainable agricultural practices.



Key Words – moisture, ash, pH, starch, TSS(Total soluble solids), texture , aroma.

INTRODUCTION

Vegetables have a unique place in diet because of their color, flavor, nutrient content and health benefits(1). They serve as rich sources of β carotene, ascorbic acid, iron, zinc, folate and dietary fiber (2). The rainfall in India is seasonal, as a result bulky amount of vegetables are available in the rainy season and under the favorable conditions during winter, all of which are not properly utilized. Some the low cost methods of preservation of vegetables include blanching, improved traditional techniques (3,4)etc. GLV"s are highly perishable due to their high water activity, therefore methods involving removal of this moisture helps in their preservation. During the dry months of the year, there is wide spread acute shortage of vegetables throughout the country and the cost will be increased beyond the purchasing limit of a poor citizen. To satisfy the needs of the people surplus vegetables must be conserved for use when required. The ideal less expensive and quite simplest method of conservation of vegetables is to drive of the surplus moisture in the fresh material and forage crops through sum of hot and dry natural air (5). The dried powder of vegetables is used to check malnutrition in India. Dried vegetable powder is added to the meals and served in government schools in Delhi under the Mid Day Meal Scheme. In West Bengal, smallscale trials of adding leaf powders of drumstick, fenugreek, curry leaf etc in badi, papad, sauce and soup powder keep up the quality and taste.

Keeping the product fresh is the best way to maintain its nutritional value, but most storage techniques require low temperatures, which are difficult to maintain throughout the distribution chain. On the other hand, drying is a suitable alternative for post harvest management especially in countries like India where exist poorly established low temperature distribution and handling facilities. It is noted that over 20% of the world perishable crops are dried to increase shelf-life and promote food security. It is the oldest and most effective method of lowering water content in order to slow down food spoilage by micro-organisms(7).

POTATO POWDER

Potato, a highly nutritious agricultural commodity with a rich source of high-quality protein, starch, basic vitamins, minerals and trace elements, is widely used as a food and industrial crop(17). With a yearly output of more than 370 million tons, potato is among the most important crops, making it the third largest after wheat and rice in total output(18). Potato flour is an indispensable intermediate raw material in processed potato food; the potato is processed into whole flour and then added to the staple food in a certain proportion (processed into a new, staple potato food product), which is conducive to improving the nutritional value of traditional staple foods, to meet the current demand for nutritious staple foods (19). However, the research and development of nutritional potato staple food products is confronted with lots of constraints. For instance, the dehydration of fresh potatoes can affect the profile of endogenous compositions, such as moisture, pasting properties and volatile and non-volatile precursors of potatoes, which can significantly affect the quality of the end products(20). In order to improve the quality of potato flour, it is essential to reduce the drying time by using modern drying technologies to replace traditional natural drying methods(21-22).

TOMATO POWDER

Tomato is a worldwide important agricultural commodity, with remarkably high concentrations of *L*-ascorbic acid, lycopene and is considered to be an important contributor to carotenoids to the human diet (23). The consumption of tomato and tomato-based products have been associated with a lower risk of developing certain type of cancers such as digestive tract and prostate cancer, which may be due to the ability of lycopene and other antioxidant components (24). The increasing interest in the antioxidant activity of lycopene (the most abundant carotenoids in tomatoes) and other functional components has been promoting the consumption of tomato and tomato-based products. However, similar to most of the fruit and vegetables, tomato creates surplus during production season and becomes insufficient during off-season. Short shelf life coupled with inadequate processing facilities results in heavy revenue loss. Thus, preservation and further processing of tomatoes are of commercial importance. Dried tomato products (i.e., tomato halves, slices and powders) are in high consumption as compared to other tomato products due to their excellent properties. Among these various dried tomato products, powder enjoys a special market. Tomato solids in powder form have many advantages, including ease of packing, transportation and mixing, and no drum-clinging loss (25). In addition, tomato powder is much in demand by dehydrated

soup manufacturers, and it also can be used as an ingredient in many food products, mainly soups, sauces and ketchup.

BOTTLEGOURD MURABBA

Bottle gourd takes the lead in the diet compared to other vegetables grown in India since it is a nutrient-dense and low-cost source. Non-bitter bottle gourd is used for eating (27). Therefore, the preparation of these foods and beverages is mostly restricted to the home (28). The various products that can be developed from bottle gourd fruit are pickles, chutney, juice, and sweets (29). Bottle gourd candy is prepared by dipping bottle gourd cubes in sugar syrup (30). A salt substitute blend and bottle gourd fruit are also used to create high fibre, low salt, and low-fat chicken nuggets (31). Bottle gourd halwa is one of the traditional Indian dairy products prepared from grated bottle gourd cooked with sugar, khoa, ghee, and flavoured by spices like cardamom. Bottle gourd is one of the high nutritional and beneficial vegetables gifted by Almighty to human beings. It contains the essential constituents required for good health and well-being and has the potential to resist, prevent, and treat various diseases. Since it possesses extraordinary properties, it can be coined as a natural protector for human beings(32).

OBJECTIVE

- 1. To evaluate sensory evaluation of prepared products.**
- 2. To study the nutritional analysis of prepared products.**
- 3. To demonstrate and trained farmer or teenagers about product development and food preservation technique.**

MATERIAL AND METHOD

Physiochemical Analysis of products

Determination of pH

The pH of the selected samples was determined by a pH meter, salinity-sodium tester with the supplied pH 4.0 buffer solution, distilled water and 50 ml beakers.

Estimation of moisture content

The moisture content was determined according to the AOAC (1984) method. Five (5) g of samples was accurately weighed into dried crucible and placed in an oven (Mettler Toledo, AB 104) at $105\pm 2^{\circ}$ C for 4 (four) hours. After drying, the samples were removed from the oven and placed in desiccators to cool for about 30 minutes and then reweighed. The process of evaporation, cooling and weighing process were repeated until constant weight was found.

Estimation of total ash

The ash was determined by the method as reported in the handbook of AOAC (1984). samples were weighed (5g) accurately in a previously cleaned and dried- weighed crucible. At first the crucible containing sample was placed in an oven (100-1050C) for 4 hrs to remove moisture. The moisture free sample was completely charred (free from carbon residues: appears in grayish-white) in a heating mantel followed by heating (ashing) in a muffle furnace at 6000C for 3 hours. Then it was removed from furnace and cooled in desiccators and weighed. To ensure complete ashing, the crucible was again heated in a muffle furnace for one hour. Then this was removed from the furnace and cooled in desiccators and weighed again.

Determination of total carotenoids

Total Carotenoids was determined according to (10). Total Carotenoid contents for all the samples under study were estimated by the standard procedure followed in harvest plus research. Here we used spectrometric method to estimate total Carotenoid content in samples.

Determination of starch

The method commonly used for starch analysis is known as the “Modified Starch Analysis”. This method involve gelatinizing the starch by heating it in the presence of water, followed by precipitation using ethanol and subsequent washing to remove impurities. The dried and purified starch is then weighed to determine its content as a percentage of the original sample(13).

Calculate the starch content as a percentage using the following formula:

$$\text{Starch content (\%)} = (\text{Weight of dried starch} / \text{Weight of potato flour sample}) \times 100$$

Microbial analysis

Microbial tests were conducted for Standard Plate Count as per the methods mentioned by (11). We use nutrient agar media for the growth of microbes and incubate at 48 hrs at 37⁰ C.

Organoleptic evaluation of products

After the preparation of products, 4 samples were selected for organoleptic evaluation according to the method (12). The Organoleptic evaluations of tomato powder were carried out by 10 judges. All the judges formed the panel were conversant with the factor governing the quality of the sample. Tomato powder was evaluated organoleptically for color, flavor, texture and overall acceptability. The taste panelists were asked to rate the samples for color, flavor, texture and overall acceptability on 1-9 point hedonic scale, when, 9=like extremely; 8=like very much; 7=like moderately; 6=like slightly; 5=neither like nor dislike; 4=dislike slightly; 3=dislike moderately; 2=dislike very much; 1=dislike extremely.

RESULT AND DISCUSSION

Physico-chemical characteristics of the bottle gourd murabba incorporated with different syrup concentrations .

Effect on moisture content- The results of the moisture content during storage of the bottle gourd murabba are given. The moisture content of the sample which was dipped in 65 °Brix syrup concentration was found to be the highest, while the lowest moisture content was observed in sample dipped in 75 °Brix. Since at the lower value of syrup concentration (i.e 65 °Brix) the osmotic dehydration is low therefore the moisture content is high.

Table no. 1.1. Change in moisture content of bottle gourd murabba samples during storage.

Variance and storage	0 days	7 days	14 days
65 Brix	11.65	10.54	9.97
70 Brix	11.87	10.76	9.47
75 Brix	12.13	10.95	9.65

Effect on ash content- Average values of ash content in bottle gourd samples were found to be ranging from 0.39-0.63% (Table1.2). High ash content was found in sample which contains higher concentration of syrup of bottle gourd.

Table no. 1.2 Change in ash content of bottle gourd murabba samples during storage.

Variance and storage	0 days	7 days	14 days
65 Brix	0.39	0.42	0.48
70 Brix	0.41	0.46	0.53
75 Brix	0.45	0.49	0.63

Effect on pH - the values of pH that are observed and are in the range of 3.41-3.64 for the bottle gourd samples. Throughout the study a lower pH was maintained in samples incorporated with sugar syrup steeping. When the syrup concentration is increases pH decreases.

Table no. 1.3 Change in pH of bottle gourd murabba samples during storage.

Variance and storage	0 days	7 days	14 days
65 Brix	3.41	3.43	3.46
70 Brix	3.45	3.47	3.59
75 Brix	3.49	3.51	3.64

Effect on (total soluble solid) - TSS (Table 1.4) shows that the result of TSS of bottle gourd murabba samples for 14 days storage period and are ranging from 24.61-32.28 was highest

for the sample with 75 °Brix syrup concentration incorporation and lowest for the sample with CaCl₂ treated.

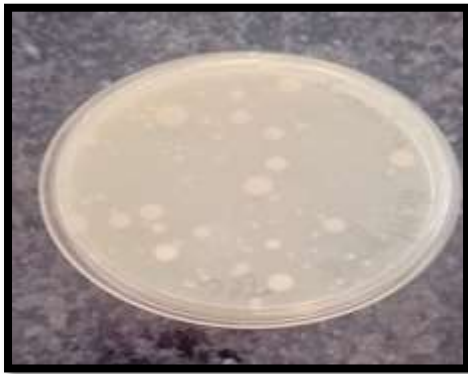
Table no. 1.4 Change in TSS of bottle gourd murabba samples during storage.

Variance and storage	0 days	7 days	14 days
65 Brix	20.37	22.78	24.44
70 Brix	21.33	23.42	25.41
75 Brix	22.49	24.72	26.43

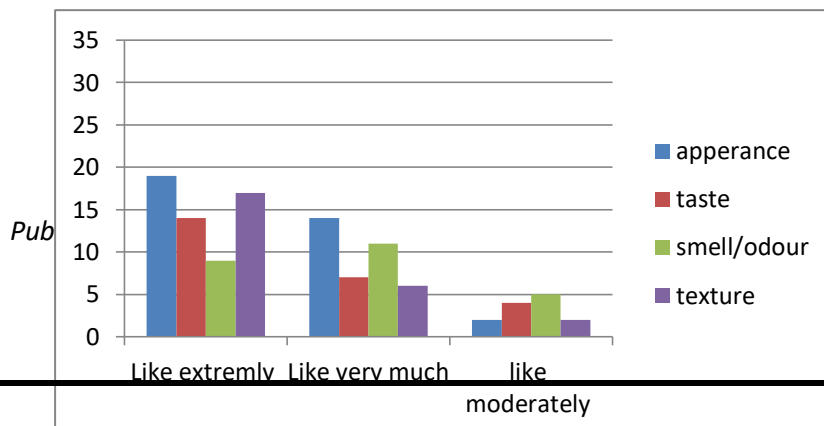
Microbial Analysis – Microbial analysis of bottlegourd murabba sample were conducted by standard plate count method. In this method we used nutrient agar media for the growth of bacteria and incubate for 48±2 hrs at 37 ° Celcius.

Table no. 1.5 Microbial Analysis

	CFU Count per gm after 24 hours of inoculation	CFU Count per gm after 48 hours of inoculation
Total Plate Count	2.30×10 ³ CFU/g	2.60×10 ³ CFU/g
Dilution (10³)		



Sensory evaluation - Samples were rehydrated and subjected for sensory evaluation in order to assess consumers’ reaction with regard to colour, flavour, mouth feel, taste, appearances and overall acceptability. Fifty members of untrained panelists were selected from students, laboratory technicians and academic staff member of department.



Physio-chemical Characteristics of tomato powder

Water activity reduced from 0.84(fresh tomato) to 0.59(tomato powder) when moisture content was reduced from 93.2 % to 7.4 % during sun drying. The tomato powder stored in polypropylene container for the analysis and to study the shelf life of product. Lycopene content was 1.41 mg per 100 g in tomato powder. Retention of total lycopene content in tomato powder was 52% compared with fresh tomato. Heat processing and storage of tomato products causes lycopene degradation to certain extent as reviewed by Nguyen and Schwartz (1999).

Table no. 1.6

Analysis/Months	0 Month	1 Month	2 Month
Moisture	25.43	29.65	30.96
Water activity	0.59	0.62	0.65
Ash	45.65	52.35	54.65
pH	4.25	4.49	4.65

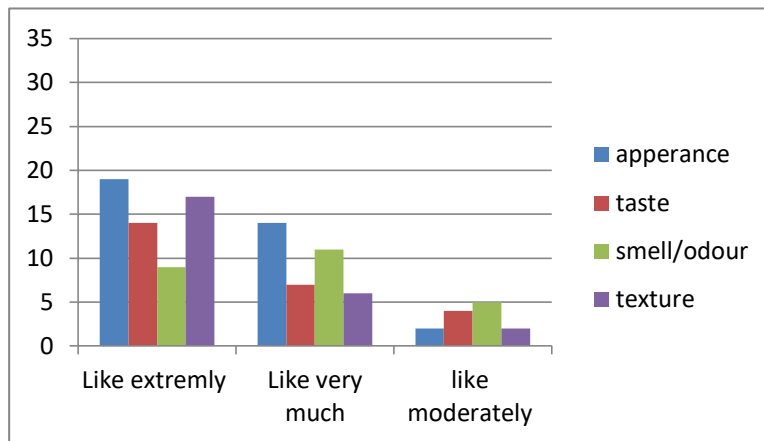
Microbial Analysis – Microbial analysis of tomato powder sample were conducted by standard plate count method. In this method we used nutrient agar media for the growth of bacteria and incubate for 48±2 hrs at 37 ° Celcius.

Table no. 1.7

	CFU Count per gm after 24 hours of inoculation	CFU Count per gm after 48 hours of inoculation
Total Plate Count	2.45×10⁵ CFU/g	2.55×10⁵ CFU/g
Dilution (10⁵)		



Sensory evaluation - Samples were rehydrated and subjected for sensory evaluation in order to assess consumers' reaction with regard to colour, flavour, mouth feel, taste, appearances and overall acceptability. Fifty members of untrained panelists were selected from students, laboratory technicians and academic staff member of department.



Physio-chemical Characteristics of Potato powder

The percentage of starch in potato powder is 56.70%. The product was stored in propylene container to study the shelf life of product which is 4 to 5 months.

Table no. 1.8

Analysis/Months	0 Month	1 Month	2 Month
Moisture%	15.46	17.89	18.56
Water activity	0.54	0.61	0.63
Ash %	8.54	8.96	9.45

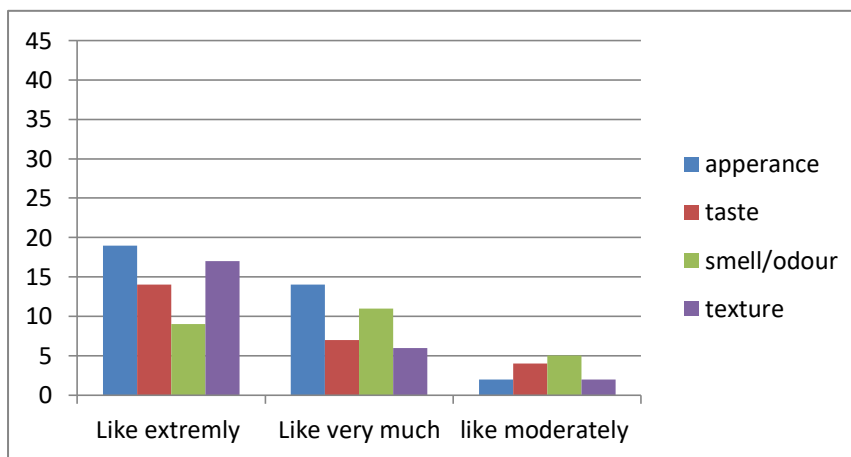
pH	5.60	5.63	5.63
----	------	------	------

Microbial Analysis – Microbial analysis of potato powder sample were conducted by standard plate count method. In this method we used nutrient agar media for the growth of bacteria and incubate for 48±2 hrs at 37 ° Celcius.

Table no. 1.9

	CFU Count per gm after 24 hours of inoculation	CFU Count per gm after 48 hours of inoculation
Total Plate Count	65×10⁴ CFU/g	65×10⁴ CFU/g
Dilution (10⁴)		

Sensory evaluation - Samples were rehydrated and subjected for sensory evaluation in order to assess consumers’ reaction with regard to colour, flavour, mouth feel, taste, appearances and overall acceptability. Fifty members of untrained panelists were selected from students, laboratory technicians and academic staff of member department.



Farmer demonstration

The farmer demonstration held at the Department of Food and Nutrition, School of Home Science, BBAU, Lucknow, was a significant step towards promoting food preservation techniques among farmers. The primary goal of the demonstration was to equip the farmers with valuable skills and knowledge in preserving potatoes, tomatoes, and bottle gourds, thereby enhancing the value and shelf life of their crops.

The training began with the preservation of potatoes in powder form using the sun drying method. The farmers were instructed on the proper technique of slicing the potatoes thinly, ensuring uniform thickness for even drying. These sliced potatoes were then spread out under the sun to dry. The sun-drying process eliminated moisture from the potatoes, making them suitable for long-term storage. Once completely dehydrated, the potatoes were ground into a fine powder. This potato powder had numerous culinary applications, including its use in

curries, fritters, and soups. It provided convenience to the farmers, as the powder could be easily stored and used as needed.

Similarly, the farmers were trained in preserving tomatoes through the sun drying method. They were taught how to slice ripe tomatoes into thin pieces and lay them out under the sun to dry. As the moisture evaporated, the tomatoes transformed into crisp and dried pieces. Once fully dried, they were ground into a powder, resulting in a concentrated flavor bomb. This tomato powder had a remarkable ability to enhance the taste of various dishes. The farmers learned how to incorporate it into curries, fritters, soups, and even sauces, amplifying the flavor profile and adding nutritional value.

In addition to the powdered preservation techniques, the farmers were educated on the preparation of bottle gourd murabba, a traditional Indian sweet preserved in sugar syrup. The process began with the farmers slicing the bottle gourd into desired shapes. These slices were then dried to remove excess moisture. The dried bottle gourd slices were subsequently preserved in a syrup made from sugar. This preservation method not only extended the shelf life of the bottle gourd but also infused it with sweetness and a delightful texture. The resulting murabba could be relished as a dessert on its own or incorporated into various culinary creations.

Throughout the training, the farmers were enlightened about the versatility of the preserved items and their potential utilization in cooking. They were introduced to the concept of utilizing potato powder and tomato powder in a range of recipes, enhancing the flavor and nutritional content of their dishes. The farmers learned how the potato powder could be employed in thickening sauces, making fritters crispier, and adding body to soups. Similarly, the tomato powder could be sprinkled over salads, mixed into marinades, or used as a seasoning in diverse preparations. By incorporating these preserved items into their culinary repertoire, the farmers could elevate the taste of their dishes while also minimizing food waste.

The farmer demonstration not only provided practical training in food preservation techniques but also emphasized the importance of reducing food waste and maximizing the yield from their harvest. The farmers learned how preserving vegetables could significantly extend their shelf life, allowing them to utilize their produce more effectively. By acquiring these skills, the farmers were empowered to explore innovative ways to utilize the preserved vegetables, opening up new avenues for culinary creativity.

In conclusion, the successful farmer demonstration conducted at the Department of Food and Nutrition, School of Home Science, BBAU, Lucknow, played a vital role in imparting valuable knowledge and skills to farmers in food preservation techniques. Through the preservation of potatoes, tomatoes, and bottle gourds, the farmers learned how to extend the usability of their produce, minimize food waste, and unlock new possibilities in culinary endeavors. The training equipped them with practical techniques and innovative ideas to make the most of their harvest, ultimately benefiting both their economic prospects and the overall sustainability of the agricultural sector.



CONCLUSION

In conclusion, this study aimed to evaluate the sensory attributes of the prepared products, including potato powder, tomato powder, and bottle gourd murabba, through sensory evaluation. Trained panelists and potentially consumers participated in the sensory analysis, providing valuable feedback on taste, texture, aroma, appearance, and overall acceptability. The sensory evaluation results will help determine the sensory quality and consumer acceptability of the preserved products. Furthermore, the study focused on conducting a comprehensive nutritional analysis of the prepared products. This analysis involved determining the macronutrient and micronutrient content of the potato powder, tomato powder, and bottle gourd murabba. The nutritional analysis provided insights into the nutritional composition and potential health benefits of these preserved items. Additionally, the study included demonstrations and training sessions to educate farmers and teenagers about product development and food preservation techniques. The training equipped them with the necessary knowledge and skills to implement effective preservation methods and explore innovative culinary uses for the preserved vegetables. By empowering farmers and teenagers with these skills, the study aimed to promote sustainable agricultural practices, reduce food waste, and enhance food security. Overall, this study contributes to the field of food preservation by evaluating the sensory quality, nutritional composition, and providing practical training on product development and preservation techniques. By bridging the gap between scientific analysis and practical implementation, this research has the potential to

benefit farmers, consumers, and the food industry as a whole, leading to improved food preservation practices, reduced waste, and enhanced utilization of agricultural produce.

REFERENCES

1. Peter A I, John J M and Olaleye ST, 2010. Nutritional Quality Parameters of Dried Tomatoes A.U.J.T. 14 (1): 25-32.
2. Negi PS and Roy SK, 2000. Effect of blanching and drying methods on b-carotene, ascorbic acid and chlorophyll retention of leafy vegetables. *Lebensm.- Wiss. Technol.* 33, 295–298.
3. Naikwade PV, Mogle UP and Jadhav BB. 2012a. Preservation of Fenugreek by using improved traditional techniques, *Bioscience discovery*, 3(1):82-86.
4. Naikwade PV, Sankpal ST and Jadhav BB 2012 b. Preservation of spinach by using improved traditional techniques, *Bioinfolet*, 9(2):30-36.
5. Chatterjee BN and Maiti S, 1978. *Silage and hay making*, ICAR, New Delhi.
6. Vyankatrao, Naikwade Pratap, Nya Tyatyasaheb Aathalye Arts, and V. S. R. S. Commerce. "Effect of drying methods on nutritional value of some vegetables." *Proceeding of the National Conference on Conservation of Natural Resources & Biodiversity for Sustainable Development. Biosci. Discov.* Vol. 6. 2014.
7. Pragati, Singham, and Birwal Preeti. "Technological revolution in drying of fruit and vegetables." *Int J Sci Res* 3.10 (2014): 705-11. Pragati, Singham, and Birwal Preeti. "Technological revolution in drying of fruit and vegetables." *Int J Sci Res* 3.10 (2014): 705-11.
8. Goula, Athanasia M., and Konstantinos G. Adamopoulos. "Stability of lycopene during spray drying of tomato pulp." *LWT-Food Science and Technology* 38.5 (2005): 479-487.
9. AOAC, Association of Analytical Chemists. 1984. Moisture in dried fruits. In: Williams S, editor. *Official methods of analysis of the Association of Official Analytical Chemists*. Arlington, Va.: AOAC. 415p.
10. Delia, B.; Rodriguez-Amaya, and Kimura, M. 2004. *Harvest Plus Handbook for Carotenoid Analysis*. International Center for Tropical Agriculture (CIAT). Series-2. pp. 8-52.
11. Gautam N, Siddiqui U. *Carpathian Journal of Food Science and Technology*. Carpathian Journal of Food Science and Technology. 2020;12(2):105-111.
12. Stone, C.V. 1985. *Sensory Evaluation Practices*. Florida: Academic Press 311p.
13. Shi, J. X.; LeMaguer, M.; Kakuda, Y.; Liptay, A. and Niekamp, F. 1999. Lycopene degradation and isomerization in tomato dehydration. *Food Research International*, 32(1), 15–21.
14. Raigond, P.; Singh, B.; Gupta, V.K.; Singh, B. Potato flavour: Profiling of umami 50 -nucleotides from indian potato cultivars. *Indian J. Plant Physiol.* 2014, 19, 338–344.
15. Yang, S.; Dhital, S.; Zhang, M.; Wang, J.; Chen, Z. Structural, gelatinization, and rheological properties of heat-moisture treated potato starch with added salt and its application in potato starch noodles. *Food Hydrocoll.* 2022, 131, 107802.
16. Dreyer, H. *Towards Sustainable Potato Production: Partnering to Support Family Farmers in Africa*. *Potato Res.* 2017, 60, 237–238.
17. Zhang, H.; Fen, X.; Yu, W.; HU, H.; Dai, X. Progress of potato staple food research and industry development in China. *J. Integr. Agric.* 2017, 16, 2924–2932.
18. Liu, X.; Mu, T.; Sun, H.; Zhang, M.; Chen, J. Influence of potato flour on dough rheological properties and quality of steamed bread. *J. Integr. Agr.* 2016, 15, 2666–2676.
19. Zeng, F.; Liu, H.; Yu, H.; Cheng, J.; Gao, G.; Shang, Y. Effect of potato flour on the rheological properties of dough and the volatile aroma components of bread. *Am. J. Potato Res.* 2018, 96, 69–78.
20. Raigond, P.; Singh, B.; Gupta, V.K.; Singh, B. Potato flavour: Profiling of umami 50 -nucleotides from indian potato cultivars. *Indian J. Plant Physiol.* 2014, 19, 338–344.

21. Bai, J.; Cai, J.; Tian, X. Crust Formation and Microstructural Changes of Ginkgo Biloba Seeds During Drying. *Food Bioprocess Technol.* 2019, 12, 1041–1051.
22. Wang, H.; Zhang, M.; Adhikari, B. Drying of shiitake mushroom by combining freeze-drying and mid-infrared radiation. *Food Bioprod. Process.* 2015, 94, 507–517.
23. H. Tapiero *et al.* The role of carotenoids in the prevention of human pathologies *Biomed. Pharmacother.*(2004).
24. G. Giovanelli *et al.* Water sorption, drying and antioxidant properties of dried tomato products *J. Food Eng.*(2002).
25. A.M. Goula *et al.* Spray drying of tomato pulp in dehumidified air: II. The effect on powder properties *J. Food Eng.* (2005)
26. A.M. Goula *et al.* Prediction of lycopene degradation during a drying process of tomato pulp *J. Food Eng.*(2006)
27. Sivaraj, N., Pandravada, S. (2005) Morphological diversity for fruit characters in bottle gourd germplasm from tribal pockets of Telangana region of Andhra Pradesh, India. *Asian Agri-History*, 9, 305.
28. Bhalla, T.C. (2007). Traditional foods and beverages of Himachal Pradesh. *Indian Journal of Traditional Knowledge (IJTK)*, 06(1), 17–24.
29. Walters, I., Bennion, C., Connolly, S., Croshaw, P.J., Hardy, K., Hartopp, P., Jackson, C.G., King, S.J., Lawrence, L., Mete, A. (2004) Synthesis and evaluation of substrate-mimicking cytosolic phospholipase A2 inhibitors—reducing the lipophilicity of the arachidonyl chain isostere. *Bioorganic & Medicinal Chemistry Letters*, 14, 3645-3649.
30. Ahmad, M.D. (2021) Innovative agricultural technologies for sustainable food and environment: A mini review. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12, 3523-3530.
31. Verma, A.K., Sharma, B.D., Banerjee, R. (2012) Quality characteristics of low-fat chicken nuggets: Effect of common salt replacement and added bottle gourd (*Lagenaria siceraria* L.). *Journal of the Science of Food and Agriculture*, 92, 1848-1854.
32. Ahmad, M. D., and I. Ahmad. "Study and quality evaluation of candy prepared by using bottle gourd." *IOP Conference Series: Earth and Environmental Science*. Vol. 756. No. 1. IOP Publishing, 2021.