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Research Article

STUDIES ON MODULATORY EFFECT OF OKARA SUPPLEMENTATION AND COOKING METHODS ON THE READY-TO-COOK PATTY

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Abstract: A convenient Ready-to cook (RTC) patty was developed with 20 %substitution with okara, a by-product of the soybean processing industry. Different methods of cooking *viz*., deep frying, shallow frying and air frying were employed and studies were conducted to know their effect on the sensorial, nutritional and textural characteristics of RTC patties. It was found that that the deep fried patty has maximum acceptability and whereas the air fried sample was only moderately acceptable with good nutritional composition. The lowest L* values were achieved in the deep fried samples and the highest b* values in the air fried samples which influence the sensorial scores of the product. The texture analysis of deep fried sample showed maximum compression force as opposed to the air fried sample. The RTC okara supplemented patty will help in effective utilization of industrial by-product as well as increase the nutritional potential of this popular snack.

Keywords: *Snack product, Okara¸ By-product utilization, Ready-to-cook, Frying*

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Introduction

Initially a 'bad' image was associated with the snacks owing to their low nutritive value and adverse effects on the health of the consumers, even though they are an important source of energy and help to bridge the gap between major meals of the day. Lately, the perception of snacks is changing and now they are looked upon as a source of nutritional package to meet our dietary needs [1]. Consumers are now aware and are seeking healthy alternatives in the snack segment though consumer acceptance of the snacks depends primarily on its organoleptic properties [2]. So, snacking should be done not only on one's preference but also on their nutritional needs. To meet the demand of the nuclear families with working women who have less time on their hands for putting together a complete meal, snacks market is seeing a great spurt [3].

Convenience foods, where the initial prepping and major processing steps are already done and only little effort is needed before consumption, are very popular nowadays. The frozen foods segment is one of these categories. It is seen that the ready-to-eat frozen vegetarian snacks available in the Indian market are high on calorie content based on carbs but low in protein content as they are primarily potato-based products. Okara, the by-product of soya milk and tofu industry has appreciable amounts of protein and fiber and has potential to be utilized by the food industry. Moreover, there are ample studies vouching for the beneficial effects of soybean products consumption on health [4, 5, 6] and its fortification in different products is being adopted to achieve complete amino acid profile and augment the protein content [7].

There is urgent need to utilize okara because of the large volume of residue produced, every 1 kg of soybean processed into soymilk/tofu, 1.1 kg of fresh okara is produced [8] whose disposal causes environmental pollution and leads to loss of nutritive and bioactive components. For increasing the protein and fibers in snacks as well as efficient utilization of processing by-products, this work was conducted to standardize a wholesome potato-based snack, RTC (ready-to-cook) patty by utilizing okara and evaluate its different cooking techniques.

Materials and Methods

Fresh okara was obtained from Garcha Pure Products Farm (Vigour soya health milk) village Deh Kalan, Sangrur, Punjab. It was immediately dried in a tray drier at 55°C till bone dry, grinded, packed in airtight containers and stored at low temperature till further utilization. Material required for patty like potatoes, breadcrumbs, onion, green chilies, coriander, spices and vegetable oil (refined soybean oil) were purchased from the local market.

Preparation of okara incorporated RTC patty

The potatoes were washed, boiled, peeled and mashed. Diced onion (5%), green chilies (1%), coriander (1%), salt (2%) and spices (1%) and breadcrumbs (5%) were added. Dried okara was added in 0, 10, 20, 30, and 40 % and mixed properly with the required amount of water to obtain the uniform mixture. The various blends were than divided into equal portions of approximately 20g each, shaped into equal thickness roundels, deep fried and subjected to sensory analysis where it was found that 20% of okara supplementation gave an acceptable product with optimum utilization of okara as well [9]. To carry out the studies further, the formed patties were dusted with flour and packed in zip locks laminated packets and stored at -18°C till further use. The patties were taken out of the freezer and immediately cooked by three methods *viz*., deep frying, shallow frying and air frying.

Deep frying was done in electric thermostatically temperature controlled deep fryer with the temperature up to 175°C for 3 minutes adding 10 pieces at a time in one liter of hot refined soybean oil. Shallow frying was done in non-stick fry pan by preheating little amount of soybean oil at medium flame and cooking 10 pieces at a time for 6-8 minutes till golden brown on both sides. Air frying was done by preheating the fryer (Kenstar Aster Digi 1500-Watt Oxy Fryer (3.5 L) model) to 200°C and cooking 10 pieces at a time for 14-16 minutes until golden brown color on the surface of snacks.

Table-1 Sensorial scores of prepared fried patties by different frying methods (fresh)

Cooking methods	Sensory Attributes			
	Appearance	Texture	Taste	Flavor
Deep Frying	8.18a (0.874)	8.18a(0.874)	8.18a(0.982)	8.09a(1.136)
Shallow Frying	7.45a(0.182)	7.36ab(0.674)	7.45ab(0.934)	7.27ab(0.647)
Air Frying	6.36b(1.286)	6.54b(1.368)	6.63b(1.203)	6.63b(1.027)

Values are mean of three replicates; Values in parenthesis are SD; values with different lowercase letters in a row are significantly different at P≤0.05

Table-2 Nutritional composition of RTC patty with different cooking methods

Cooking Methods	Parameters (%)						
	Carbohydrates	Fat	Protein	Ash	Fiber	Moisture	Energy (kcal)
Deep Frying	30.14(0.597)	9.50(0.071)	12.5(0.637)	3.99(0.037)	4.51(0.048)	39.35(0.074)	256.08(0.395)
Shallow Frying	29.88(1.29)	8.6(0.070)	12.25(1.22)	3.47(0.021)	4.17(0.095)	41.634(0.054)	245.92(0.620)
Air Frying	43.10(0.696)	1.4(0.071)	12.25(0.66)	5.1(0.026)	4.61(0.019)	33.52(0.011)	233.99(0.382)

Values are mean of three replicates; Values in parenthesis are SD

Table-3 Color and textural properties of RTC patty with different cooking methods

Cooking Methods	Parameters			
	L*	a*	b*	Compression force(N)
Deep Frying	40.455(5.706)	13.48(2.206)	22.01(5.125)	1370.89
Shallow Frying	46.67(2.227)	7.33(1.933)	23.56(1.663)	900.90
Deep Frying	46.67(2.227)	7.33(1.933)	23.56(1.663)	514.96

Values are mean of three replicates; Values in parenthesis are SD

Sensory Evaluation

The product was subjected to sensory evaluation acceptability by a semi-trained panel of judges ranging between 20 to 58 years on a 9-point hedonic scale. Water at room temperature was provided to rinse the mouth in between two samples.

Functional properties

Dried okara was evaluated for its functional properties *viz*., Water Absorption Capacity (WAC), Oil Absorption Capacity (OAC), Water solubility index (WSI), Water Absorption Index (WAI) by following the standard protocols as given by Rehal *et al* [10].

Proximate composition

The dried okara and the developed patty were evaluated for its crude fat, fibre, protein and ash content by the standard AOAC procedures [11]. The carbohydrate content was calculated by difference method [12]. Energy content in kilocalories was calculated by multiplying protein, carbohydrate and fat content by 4, 4 and 9 respectively and finding the sum of it in kcal/100g [13].

Color analysis

The color values of patty samples were measured using digital type Hunter Laboratory Instrument model CIE 1996 (Hunter Associates Laboratory, Inc., Reston, Virginia, USA). The results evaluated are the averages of three replicates of both the sides of each fried samples in the form of 'L* values is measure of lightness variables for 100% lightness or Darkness, 'a*' and 'b*' values are (redness (+) or greenness (-)), and (yellowness (=) or blueness (-)) respectively. A white calibration plate (L= 91.08), a= -1.25 and b= 1.43) was used as a standard for the measurements [14].

Texture analysis

The patties cooked by different techniques were subjected to texture analysis using TA- XT texture analyzer (Stable micro systems model TA-HDi, UK) with SMS P/75 probe to evaluate the crust hardness [15].

Statistics

Data was analyzed using analysis of variance. Means with significance were tested using least significant difference (LSD) test. Significance was accepted at p≤ 0.05. STATPAC (OPSTAT) was used to analyze the data.

Results and Discussion

Sensory evaluation

The sensory analysis of the product revealed that the different cooking techniques have a profound effect on the sensorial parameters of the patty [Table-1]. The appearance parameter of the deep fried patty obtained maximum score; the dark brown crust has higher acceptability, which results due to the production of Maillard's reaction products during frying [16]. The air fried patty developed least browning of crust and received least scores whereas the appearance score of the shallow fried patty was significantly at par with the deep fried samples.

In the case of texture, similar results were obtained, as the deep fried product develops a crispy texture which was most sought after. The scores for the shallow fried and air fried samples were significantly at par for the texture parameter as shown in [Table-1]. Regarding the scores for taste, the deep fried samples received the maximum score as the uptake of fat during frying adds to the mouth feel, and the lack of it in the air fryer leads to least scores for taste. Similar observations were noted for the flavour parameter and the overall acceptability of the deep fried was maximum while the shallow fried was significantly at par with both deep fried and air fried samples.

Functional properties

Functional properties play a significant role in the utilization of an ingredient in a food product and to know about its effect in a food matrix. The water absorption capacity (WAC) of dried okara was 9.44ml/g which might be due to the presence of polar amino acid residues in the proteins that have high affinity for water molecules as suggested by [17]. The oil absorption capacity (OAC) was found out to be 3.97ml/g owing to the presence of hydrophobic amino acids in the proteins which show greater binding towards lipids [18]. These properties are further helpful for calculation and selection of water and oil amount for making any okara fortified based food like cookies, patties *etc*.

The water absorption index (WAI) of dried okara was evaluated as 6.22g/g. Intrinsic properties affecting water binding properties of food with high protein contents include amino acid composition, protein conformation and surface polarity [19]. The Water solubility index (WSI), water solubility index most commonly used to measure the amount of starch present in sample. The WSI was evaluated at about 8.87%. All functional properties of okara or any dried products which we use in developing new foods either by incorporation or as a main ingredient, affects the texture of foods a lot, as its interaction with water or oil within foods effects various properties of the final product.

Proximate composition

The proximate composition of the okara powder shows that it is a high protein by-product having 24% of protein content, along with a fat content of 13.26%. The presence of crude fibre at 18% and ash content of 4.02% was also determined. The carbohydrates content came out to be 54.75%. With this composition, it is an ideal food supplement and should be utilised to the maximum to meet the nutritional needs of the masses.

The nutritional composition of the ready to cook patty by different cooking methods are listed under [Table-2]. Maximum loss of moisture is seen in the air fried sample due to the time taken for the crust development, which was more, whereas, in the deep fried and shallow fried samples the high temperature of the oil and the pan help to seal the crust and retain maximum moisture within the patty. The fat content of the deep-fried patty is maximum as it takes up oil while frying whereas for the air fried sample, the fat content is least (1.4%). The addition of okara leads to an increase in protein content of the patties upto 12.25%. Most of the vegetarian ready to cook snacks available in the market have a protein content of 2 to 3% [14]. This increment will help to meet the nutritional needs of the consumers. Likewise, the potato based snacks available have low amount of fiber [3] but okara addition results in adequate amount of fibre in the patties ranging from 4.17 -4.61%. The ash content in the air fried sample was highest as there was no leaching of the content in oil. This result is in confirmation by the work done by Teruel *et al* [20] who compared different frying techniques for making potato based French fries. The maximum amount of calories can be derived from the deep fried sample and least by consuming the air fried sample.

Color and texture analysis

The colour and texture analysis of the patties prepared by different cooking methods are tabulated under [Table-3]. It shows that the maximum darkening was in deep fried product having least L* values of 40.455. This might be due to the maillard's reaction products as suggested by Rehal et al, 2022 in their studies on tomato pomace enriched RTC snack. Likewise, it also shows higher values of a* values which depict the redness of the product due to browning and caramelised product. The air fried sample was lightest in colour and had maximum b* values indicating increased yellowness in the product. The texture analysis shows that the deep fried product needs maximum compression force which might be due to the crust development when the product comes in contact with the hot oil whereas the air fried product has least force as the surface does not seal. The shallow fried product has intermittent patches of crust where the product comes in contact with the hot pan.

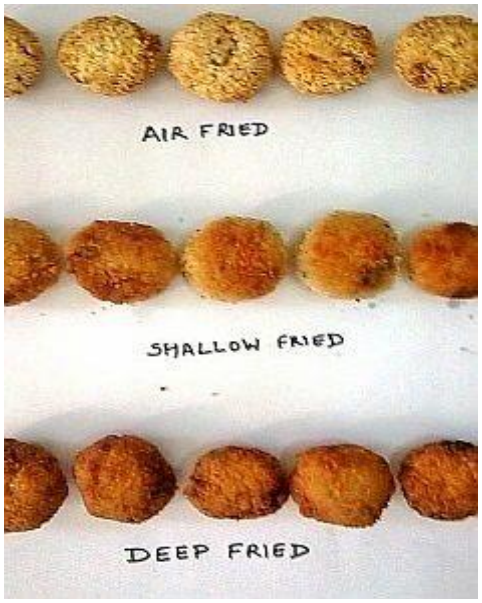

Fig-1 Pictures of RTC patties by different cooking methods

Conclusion

The present study reveals that the RTC patty having 20% of okara shows a substantial increase in its nutritional profile and different frying methods can be employed for end use depending on the preference and need of the consumers. It is observed that the traditional method of deep frying shows maximum acceptability but also results in increment in the calorie content of the patty. This product can help in effective utilization of this nutritionally valuable by-product and achieve sustainable goals and at the same time provide a convenient as well as nutritionally enhanced snack product to the consumers to meet their hunger pangs.

Application of research: This work will help in utilization of a valuable by-product into a snack with enhanced nutritional properties and helps in making choice of the method of cooking as per the priority of the consumer. The by-product utilization is an important step to harvest the nutritional content, reduce food wastage and minimize environmental pollution and disposal issues.

Research Category: Food Science and Technology

Abbreviations: RTC-Ready-to-cook, WAC-Water Absorption Capacity, OAC-Oil Absorption Capacity, WSI-Water solubility index, WAI-Water Absorption Index

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Study area / Sample Collection: Deh Kalan, Sangrur, Punjab

Cultivar / Variety / Breed name: Soybean

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References

[1] Nakano S., and Washizu A. (2020) *Journal of Health, Population and Nutrition*, 39(1), 1-6.
[2] Rehal J., Kaur G., Kaur A., Singh A. (2017) *Journal of Krishi Vigyan*, 5(2), 15-21.
[3] Rehal J., Aggarwal P. and Dhaliwal I. (2021) *International Journal of Current Microbiology and Applied Science*, 10(2), 1231-1238.
[4] Qin P., Wang T., Luo Y. (2022) *Journal of Agriculture and Food Research*, 7.
[5] Jayachandran M. and Xu B. (2019) *Food Chemistry*, 271, 362-371.
[6] Bolla K.N. and Santhi S.K.V. (2015) *International Journal of Scientific Technology and Research*, 4(7), 50-53.
[7] Singh A.K., Kadam D.M., Sexena M. and Singh R.P. (2009) *African Journal of Biochemistry Research*, 3, 130-13.
[8] Voss G.B., Sousa V., Rema P., Pintado M.E., Valente L.M.P. (2021) *Animals*, 11, 590.
[9] Beniwal V. and Rehal J. (2017) *Emerging Technologies Insight. Published by Gujran wala Guru Nanak Institute of Management and Technology, Ludhiana*, 167-69.
[10] Rehal J., Beniwal V., & Gill B.S. (2019) *Legume Research*, 42(1), 39-44.
[11] AOAC (2016) *Association of Official Analytical Chemists (edition 20th), Washington DC.*
[12] Farris, Flores, Shanklin, & Whitworth (1995) *Applied Engineering in Agriculture*, 11(4), 567-572.
[13] Singh K.K., Mridula D., Barnwal P. and Rehal J. (2013) *Food Bioprocess and Technology*, 6(2), 598-605.

[14] Rehal J.K., Aggarwal P., Dhaliwal I., Sharma M., Kaushik P.A. (2022) *Horticulturae,* 8,403.
[15] Kaul S. and Rehal J. (2022) *Asian Journal of Dairy and Food Research*, DR-1839, 1-6.
[16] Raleng A., Singh A., Chavan P., Attkan A., and Singh B. (2019) *Journal of Food Processing and Preservation*, 43(7).
[17] Yusuf A.A, Ayedun H. & Sanni L.O. (2007) *Food Chemistry*, 111, 277–282.
[18] Lawal O.S., Adebowale K.O. (2004) *Nahrung/Food*, 48(2), 129-136.
[19] Barbut S. (1999) *Methods of Testing Protein Functionality, Hall, G.M. (Ed.). Blackie Academic and Professional, New York*, 186-225.
[20] Teruel M.D.R., Gordon M., Linares M.B., Garrido M.D., Ahromrit A. and Niranjan K. (2015) *Journal of Food Science*, 80(2), E349-E358.