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Effect of substitution of selected tribal crops of Himachal Pradesh on the sensory acceptance and chemical composition of *Churros*

Anju Rani* and Sangita Sood

Department of Food Science, Nutrition and Technology
College of Community Science
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.

*Corresponding author: anjurani355@gmail.com

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Abstract

The research was conducted to develop healthy *Churros*, a traditional recipe of Spain by utilizing selected tribal crops of Himachal Pradesh namely-Proso millet (*Panicum miliaceum*) Field Pea (*Pisum sativum* var. *arvense*) and Hull-less barley (*Hordeum vulgare* L). These crops are rich sources of protein, β-glucan, complex carbohydrate, vitamins and minerals. The product was developed by using these crops and evaluated subjectively and objectively as well. The sensory evaluation was done with 15 panel members using Nine Point Hedonic Scale. The result shows that the developed product was assessed highly acceptable by the consumers. The overall acceptability was found in the range of 7.48 to 7.79. *Churros* prepared with 100 per cent barley flour (CH_3) bagged maximum acceptance i.e. 7.79 followed by CH_0 7.77 (100 % refined wheat flour), CH_2 7.59 (100 % proso millet flour) and CH_1 7.48 (100 % field pea flour) respectively. The moisture, ash, crude protein, fat, crude fiber, carbohydrate and energy content of developed product was found in the range of 2.51 to 3.90 per cent , 0.82 to 1.68 per cent, 10.01 to 17.77 per cent, 19.41 to 32.39 per cent, 0.36 to 4.28 per cent, 50.45 to 57.40 per cent and 463.94 to 542.67 kcal/100 g, respectively.

Key words: *Churros*, sensory evaluation, protein, tribal crops.

Malnutrition is a critical issue contributing to morbidity and mortality among children all over the world. According to the estimates of FAO (2017), after a prolonged decline in world hunger appears to be on the rise again. The estimated number of undernourished people increased from 777 million in 2015 to 815 million in 2016; 155 million children under five years of age are chronically malnourished (FAO 2017). India is 'on course' to meet the target for stunting, but 34.7 % of children under 5 years of age are still affected, which is higher than the average for the Asia region (21.8 %). India has made no progress towards achieving the target for wasting, with 17.3 % of children under 5 years of age affected, which is higher than the average for the Asia region (9.1 %) and among the highest in the world. The prevalence of overweight children under 5 years of age is 1.6 % and India is 'on course' to prevent the figure from increasing (Global Nutrition Report 2020). India is home to 46.6 million stunted children, a third of world's total as per global nutrition report, 2018. Nearly half of all under-5 child mortality in India is attributable to under-nutrition. Children of today are citizens of tomorrow, and hence improving nutritional status of children becomes extremely important (Singh 2020). So, it is the need of the hour to formulate and provide healthy, attractive and nutritious food supply to the vulnerable segment of the society.

Protein malnutrition is one of the major nutritional problems in the developing world. The specific maladies like kwashiorkor and marasmus are prevalent in the children owing to protein deficiency, whereas in adults results in poor health and reduced work capacity. Bridging the gap between increased food consumption and production is amongst the most challenging tasks around the globe especially in developing countries (Habicht 2008). The existing problems of food security and malnutrition coupled

with escalating population, uncertain crop yield and high cost of animal based food supplies have urged to identify and incorporate unconventional protein sources to enrich the traditional formulations (Awan, 2000) like *Churros*, a traditional recipe of spain and it is very popular among children as well as in adults. *Churros* are pieces of fried dough coated with cinnamon and sugar, a common street food in Spanish and Latin American cultures that has gained popularity in America in the past decade. In Spain, *Churros* have been popular in the street sides and its stalls are called "*Churreria.*" The *Churros* continued to develop in different countries from plain, thin stick to knotted, curved, curled and can be stuffed with different fillings in varied flavors (Eduzaurus 2020).

Keeping in mind the worse condition of malnutrition amongst people nowadays, an attempt was made to innovated the recipe, "*Churros*" consisted of mainly these selected tribal crops i.e. Hull-less barley, Field pea and Proso millet. The aim is to help and lessen health problems by the preparation of energy and protein rich *Churros* especially for children who are suffering from malnutrition. These crops are rich source of nutrients as well as showed positive health effect to the people suffering from metabolic diseases. No attempts have been made on this product by using these types of crops as well.

Materials and Methods

Procurement of Materials

The grains of selected crops were collected from local landeries of the Regional Research Station, Bajaura and Sangla (Tribal areas of Himachal Pradesh). The procured samples were cleaned manually for removing any kind of adhering dust, debris and foreign particles. The grains were then ground into a fine powder with the help of stainless steel mixer grinder and stored in airtight food-grade polyethylene terephthalate containers at ambient temperature for further analysis. The other required materials were purchased from the local market of Palampur. The analytical grade chemicals and reagents were used for precision.

Preparation of Product

Churros which is basically a traditional Spanish recipe, It is a fried dough pastry, quite popular amongst children and youngsters. Basically they are made up by using refined wheat flour. Presently it was attempted to prepare nutritionally dense *Churros* from field pea, proso millet and hull-less barley flour. The *churros* were prepared by using CH_0 (100 % refined wheat flour), CH_1 (100 % field pea flour), CH_2 (100 % proso millet flour), and CH_3 (100 % hull-less barley flour). *Churros* were prepared in the Food laboratory. All required ingredient were measured separately. All the four formulations were prepared separately (Table 1).

Flow chart for the preparation of *Churros*

Sieved the flour (as per formulation)
⇩
Heated 100 ml water with 15 ml oil in a non stick pan
⇩
Added 15 g sugar and stirred till dissolved
⇩
Switched off heat (when water is hot)
⇩
Added formulation to the hot water
⇩
Mixed rigorously till it formed a soft dough
⇩
Transferred the dough to a piping bag fitted with a big star nozzle
⇩
Piped directly into the pan for frying
⇩
Pieces cut into 2"size
⇩
Fried till light golden at medium flame
⇩
Sprinkled sugar and cinnamon powder over the Churros

Chemical analysis of *Churros*

Nutritional dense *Churros* were evaluated for their chemical composition. The chemical composition i.e. moisture, crude ash, crude protein, crude fat, crude fiber, carbohydrate and energy content of the *Churros* was determined by following the standard procedure as laid down in literature of AOAC (2010). The fat content was analyzed by means of Soxhlet extraction method, and protein content was determined by the Kjeldahl method. The ash content of the samples was estimated by means of Muffle furnace operated at temperature of 550° C. analysis was carried out in triplicate to reduce determinants error.

Sensory evaluation

The samples were evaluated organoleptically for checking the consumer's acceptability. The parameters like colour, flavor, texture, taste and overall acceptability were used at Nine Point Hedonic Scale Performa. The samples were evaluated by a panel of semi-trained judges from the department. The index of acceptance (IA %) was measured by using the equation given by Schumacher *et al*. (2010):

Index of Acceptance (%) = M/9*100

Where, M = the average of evaluations carried out by the sensory panel

Statistical analysis

The experiments were carried out in triplicate and the data obtained was presented as mean ± standard deviation. The obtained data were subjected to Analysis of Variance (ANOVA) using OP Stat software, for the analysis of commonly used CRD experimental design. The obtained data were interpreted at 5 per cent level of significance ($pd \leq 0.05$).

Results and Discussion

Moisture

The data in table 2 indicated that the per cent moisture content. It was found highest in CH_2 (3.90 %) followed by CH_0 (3.02 %), CH_3 (2.71 %) and lowest moisture content 2.51 per cent was found in CH_1. Regarding this parameter all the treatments varied significantly with control sample however CH_3 varied non-significantly from control sample. This variation may be due to the nature of different flours and their functional properties. The selection of different crops as the base also affected the moisture content of the prepared product.

Crude Ash

The data regarding the ash content in *Churros* has been presented in table 2. A critical look at the obtained data reveals that the maximum (1.68 %) and the minimum (0.82 %) values for ash content were observed to be in samples CH_2 and CH_0. Whereas, the sample CH_1 and CH_3 obtained intermediate values i.e. 1.48 and 1.16 per cent respectively. *Churros* prepared with 100 per cent Proso millet flour were found to contain the maximum ash content. This might be subjugated to the good amount of mineral content in proso millet as is evident from the raw data. The ash content obtained in the *Churros* preparations decreased in the same trend that was found to occur for the ash content of base crops used for preparing *Churros*. The ash content increased significantly in the prepared samples as compared to control. It was also observed by Queiroz *et al*. (2020) for the ash content in their *Churros* preparation.

Crude Protein

A glance at the data in the table 2 reflects that protein content was found to be significantly highest in treatment CH_1 i.e. 17.77 per cent followed by CH_2 (12.73 %) and CH_3 (12.08 %). The control sample (CH_0) was found to have the significantly lowest protein content 10.01 per cent. The high protein content found in CH_1 is likely due to the use of field pea flour which is a protein rich crop. *Churros* prepared from proso millet (CH_2) showed intermediate value as it contains less protein when compared to field pea and barley contains the lowest value for protein amongst the selected crops. Consequently, CH_3 (100 % barley flour) showed minimum value for protein (12.08 %) amongst all the *Churros* preparations from the different selected crops. A significant increase in the protein content was found in the prepared samples as compared to control. Comparable differences in the protein content of *Churros* prepared with Tannin and tannin free sorghum varieties has also been reported by Queiroz *et al*. (2020).

Crude Fat

The data presented in table 2 reflect the fat content recorded in *Churros*. It was found to be significantly highest in the CH_3 sample, i.e. 32.39 per cent followed by 28.40 per cent, 27.54 per cent and 19.41 per cent in CH_0, CH_2 and CH_1 respectively. The maximum and minimum crude fat content was found in *Churros* prepared by 100 per cent hull-less barley

and 100 per cent field pea flour. This might be due to the oil absorption capacity that was found to be the highest in barley flour and lowest in field pea flour. Proso millet exhibited the intermediate value for oil holding capacity as well as crude fat content in *Churros* prepared with proso millet.

Crude Fiber

The crude fiber content was found to be significantly highest in CH_1 i.e. 4.28 followed by 3.70, 0.95 and 0.36 per cent in CH_2 , CH_3 and CH_0 (control) respectively. *Churros* prepared with field pea (CH_1) and proso millet (CH_2) reveal higher content of crude fiber as compared to *Churro*s prepared from hull-less barley flour (CH_3). This might be due to the fact that hull-less barley flour contains less amount of fiber, whereas proso millet and field pea are rich in fiber content. The prepared samples exhibited a significant increase in the crude fiber content as compared to the control. Queiroz *et al*. 2020 also reported similar results.

Carbohydrate

The data regarding the total available carbohydrate was depicted in table 2. As is clear from the table the carbohydrate content was decreased significantly from CH_0 sample to formulation CH_1 and CH_2 i.e. 57.40, 54.55 and 50.45 per cent respectively. Though the difference in carbohydrate varied non-significantly in between sample CH_2 and CH_3 i.e. 50.45 and 50.70 per cent respectively. The difference might be due to the other constituents like ash, protein and fat present in formulations.

Energy

Table 2 illustrated the energy value in *Churros*. The energy content was found to be the highest, i.e. 542.67 Kcals/100 g in sample CH_3 followed by CH_0 (525.21Kcals/100 g), CH_2 (500.58 Kcals/100 g) and CH_1 (463.94 Kcals/100 g) respectively. All the *Churros* preparations varied significantly in their energy content. The maximum energy value was found in *Churros* prepared with hull-less barley flour. This can be correlated to its maximum fat content as compared to all other formulations. The fat content of a food product directly affects the total energy content. The depicted data indicates that the substitution of these tribal crops with refined wheat flour resulted in a significant increase in the crude ash, protein and fiber content whereas, a significant decrease in the total available carbohydrate content of *Churros*. The difference observed in the chemical constituents of *Churros* is relatable to the substitution in the raw ingredients used for its preparation.

Sensory evaluation of *Churros*

Sensory evaluation is an indispensable part of product development; if the product is not acceptable by the consumers then its nutritional composition is rendered futile. The physical appearance of prepared *Churros* is depicted in Figure 3.

Colour

Colour plays an important role in the acceptance of any product by the consumers as it spikes the taste buds. The colour scores of *Churros* have been evaluated and presented in table 3. The sample CH_2 recorded the highest score (8.25), followed by 8.17, 8.08 and 7.83 for CH_0, CH_3 and CH_1 respectively. The proso millet flour is light in colour and consequently, the sample CH_2 prepared with 100 per cent of this flour recorded the maximum colour score. This trait positively correlated to its acceptability.

Flavor

The flavor is a blend of taste and aroma and the data regarding this is presented in table 3 for *Churros*. The score for flavor was observed to be the highest for the CH_0 sample (7.58) followed by sample CH_3, CH_1, and CH_2 i.e. 7.50, 7.42 and 7.29, respectively. The analysis of functional properties of barley has revealed high oil absorption capacity which is known to improve the mouthfeel and flavor retention of a product. Due to this reason, the CH_3 sample prepared using 100 per cent barley flour is likely to have scored maximum for flavor attribute amongst the preparations using the test crops.

Texture

Food texture is defined as those properties of food that are sensed by touch in the mouth and hands. As is evident from table 3 the highest texture scores for *Churros* bagged by the CH_3 i.e. 7.92, followed by sample CH_0 and CH_2 7.58 and 7.38 whereas, the minimum score was given to sample CH_1 (7.33).

Taste

The result regarding this parameter is depicted in table 3. As is evident from the data the highest scores for taste were bagged by the CH_0 7.75 followed by samples CH_3, CH_2 and CH_1 i.e., 7.67, 7.46 and 7.33 respectively. The minimum scores were obtained by sample CH_1 prepared by 100 per cent field pea flour.

Table 1. Ingredients used in formulations

Ingredients	CH_0 (Control)	CH_1 (Field Pea)	CH_2 (Proso Millet)	CH_3 (Hull-less Barley)
Refined wheat flour	100 g	-	-	-
Field pea flour	-	100 g	-	-
Proso millet flour	-	-	100 g	-
Hull-less barley flour	-	-	-	100 g
Oil for doughFor frying	15 ml	15 ml	15 ml	15 ml
Water	100 ml	100 ml	100 ml	100 ml
Sugar	10 g	10 g	10 g	10 g
Baking powder	2.5 g	2.5 g	2.5 g	2.5 g
Icing sugar	For icing	For icing	For icing	For icing
Cinnamon powder	2 g	2 g	2 g	2 g

Table 2. Chemical composition of *Churros*

Parameters / Samples	Moisture (%)	Crude ash (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Carbohydrate (%)	Energy (Kcals/100 g)
CH_0 (Control)	3.02	0.82	10.01	28.40	0.36	57.40	525.21
CH_1 (Field Pea)	2.51	1.48	17.77	19.41	4.28	54.55	463.94
CH_2 (Proso Millet)	3.90	1.68	12.73	27.54	3.70	50.45	500.58
CH_3 (Hull-less Barley)	2.71	1.16	12.08	32.39	0.95	50.70	542.67
CD ($P \leq 0.05$)	0.32	0.17	0.78	1.03	0.28	0.82	5.86

Table 3. Sensory scores for *Churros*

Parameters / Samples	Colour	Flavor	Texture	Taste	Overall acceptability
CH_0 (Control)	8.17	7.58	7.58	7.75	7.77
CH_1 (Field Pea)	7.83	7.42	7.33	7.33	7.48
CH_2 (Proso Millet)	8.25	7.29	7.38	7.46	7.59
CH_3 (Hull-less Barley)	8.08	7.50	7.92	7.67	7.79
CD ($P \geq 0.05$)	0.61	0.65	0.66	0.61	0.48

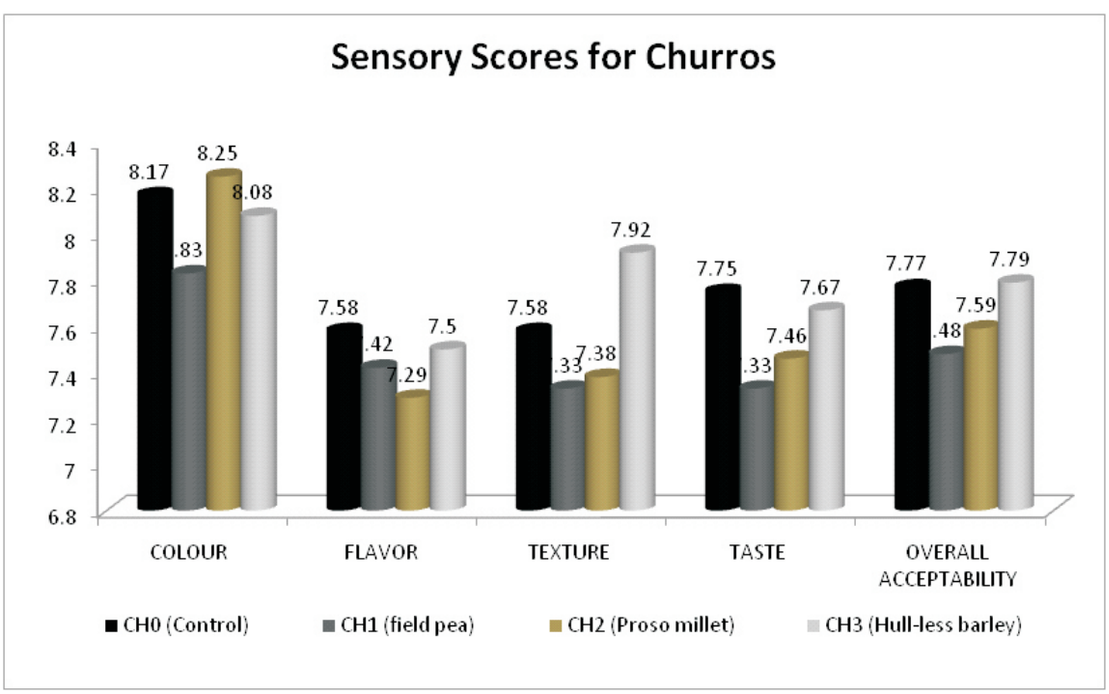


Figure 1. Sensory Evaluation for *Churros*

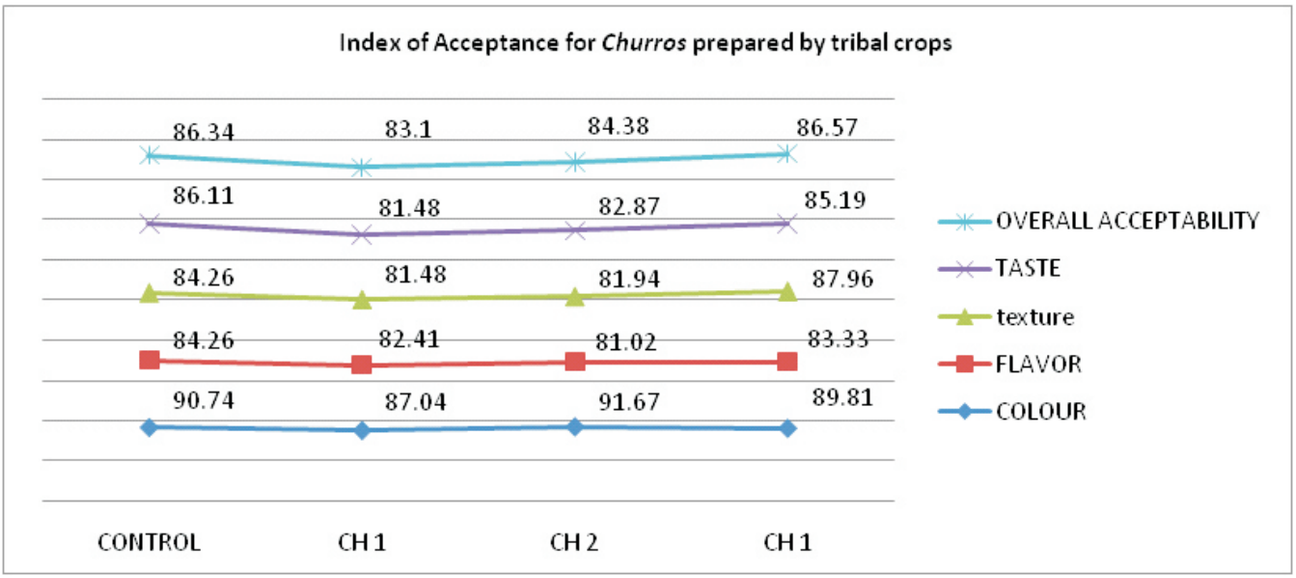
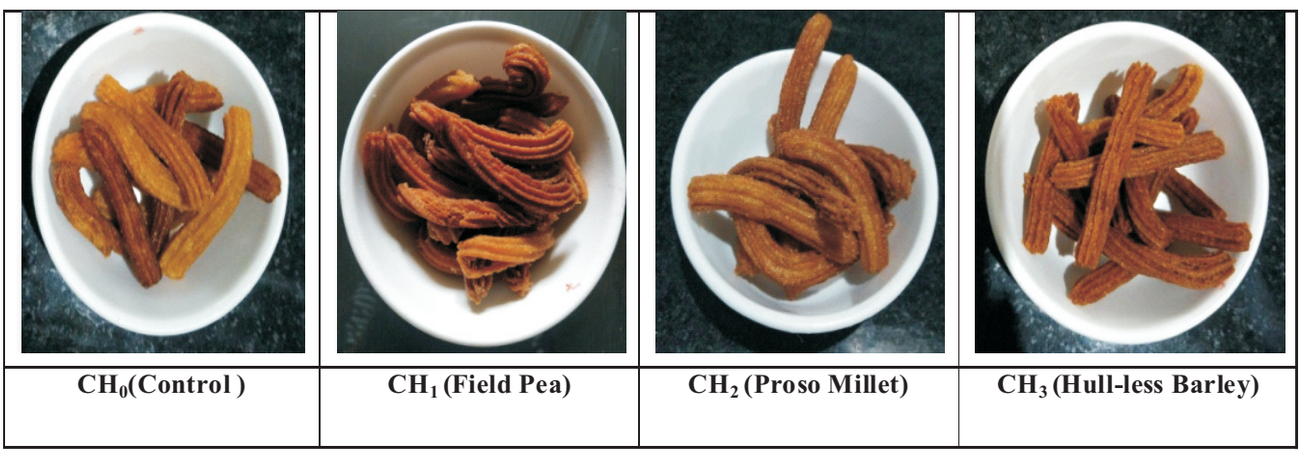


Figure 2. Index of Acceptance of *Churros* prepared by tribal crops



CH_0(Control)	CH_1 (Field Pea)	CH_2 (Proso Millet)	CH_3 (Hull-less Barley)

Fig.3 Formulations of *Churros* prepared from selected tribal crops

Overall Acceptability

Overall acceptability is the combination of colour, flavor, taste and texture. The data regarding the overall acceptability of *Churros* is shown in table 3. The overall acceptability score was found to be the highest 7.79 in CH_3 followed by CH_0, CH_2 and CH_1 i.e. 7.77, 7.59 and 7.48, respectively. The sensory scores varied in all the sensory parameters and treatments might be due to the use of different flours for the preparations. *Churros* prepared with 100 per cent barley flour bagged maximum scores for overall acceptance. This might be due to good functional properties of barley flour. The sensory acceptability of control (CH_0) and other formulations was fallen in the range of like moderately to like very much though varied non-significantly to each other.

Conclusion

From the aforesaid discussion it is inferred that refined flour which is used traditionally for the preparation of *Churros* can be replaced by barley, field pea and proso millet flour which found its acceptability not only with the consumers but at the same time nutritional value is also improved.

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Conflict of interest: The authors declare that they have no conflict of interest of any kind in this paper.

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