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Documentation of *chakli* recipes and evaluation of commercial *chakli* for physico-chemical and sensory attributes*

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Abstract: Documentation of fifty *chakli* recipes from sources like cookery books, magazine and internet revealed that rice and black gram dhal were the most common ingredients in *chakli* preparation. Wide variation was observed among the documented recipes with respect to ingredients and processing methods. An investigation was also carried out in Dharwad local market to evaluate the commercial *chakli* for the fat content and sensory attributes. Twenty three *chakli* samples from different shops were collected randomly, out of which 70 per cent were homemade. The fat content varied from 17.6- 42.3 per cent with a mean of 31.71 per cent and there was a significant difference between the samples. The result also showed that 52, 43, 39, 35 and 34 per cent of the *chakli* were considered as 'like slightly' and 'like moderately' in context with appearance, colour, texture, taste and overall acceptability, respectively with a significant difference between the samples. The study concludes that commercial *chakli* samples varied greatly in terms of quality.

Key words: Documentation, Ingredients, Little millet, Quality parameters, Sensory evaluation

Introduction

Among the convenience foods, a major share of market belongs to the category of deep fried snacks. These are manufactured by organized sector as well as cottage industries. The origin of most of these products can be traced to the traditional practices of better preservation techniques for which, fried foods naturally became a choice due to their shelf stability (Kumari and Prakash, 2009). Snacks contribute an important part of many consumers in daily nutrient and calorie intake (Chakraborty *et al*., 2011). Indian market is so diverse and large with over 1,000 different snack products and almost 300 types of savoury items. In India, a number of snack food items are prepared from a different raw materials like besan (bengal gram flour), maida (refined wheat flour), urad (black gram) dhal, moong (green gram) dhal, alone or in combination with other cereals and legumes/ pulses. Their manufacturing processes may include cleaning, pre-treatment, soaking, roasting, frying etc. (Ravi *et al*., 2011). "*Chakli*" is a common term for a variety of fried snacks that can be made using different combination of ingredients. The main ingredient for all types of "*chakli*" is rice flour. "*Chakli*" are delicious savouries that are generally made at home and kept in airtight containers for eating as fancied as well as enjoyable, crunchy and satisfactory snack. They are exclusively South Indian, but a different version of "*chakli*" is made in Western India under the name of *Chakkali*, out of *channa dal* and sold as a packaged savoury (Anon., 2011). Sensory evaluation is considered to be an important analytical tool in the present day competitive corporate environment. Measuring the sensory properties and determining the importance of these properties, as a basis for predicting acceptance by the consumer represent major accomplishments for sensory evaluation (Bodyfelt *et al*., 1988). Since Indian market are flooded with diverse recipes for a particular snack,the taste and acceptability of the same product also varied. For consumers, the perceivable sensory attributes, color, flavor, texture, and taste are the deciding factors in food acceptance (Pal *et al*., 1995), Since *Chakli* is a traditional snack and is mostly prepared locally, the *chakli* available in the market has different taste and acceptability. So, an objective was set to document different types of *chakli* recipes available to sort out the ingredients and different methods of preparation of *chakli* and to evaluate the commercial *chakli* available for physico-chemical and sensory attributes.

Material and methods

Different *chakli* recipes were collected from sources like cookery books, magazine and internet and the collected recipes were evaluated for types and forms of cereals and pulses used, pre-treatment given to cereals and pulses, common and combination of spices used, types of fats and oils used for shortening and other ingredients used in *chakli* recipes.

Chakli samples were procured from the shops of different areas. Both branded and unbranded samples were collected and parameters like major ingredients and cost were noted. The samples were stored safely in an aluminium tin which was later subjected for physico-chemical and sensory attributes. Dimensional analysis of the sample was done with a digital vernier calliper with a millimetre precision. The diameter of the whole sample was recorded and the diameter of the *chakli* strands for the height of the *chakli* was also measured in triplicates and the average was reported in millimetre (Singh, 2009). Known weight of sample was placed in a 100 ml measuring cylinder and filled with sand. The difference in volume was calculated and expressed in g/cm^3 as density. Five replicates were done and average was reported (Singh, 2009). Moisture

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and fat estimation were done as per the standard AOAC procedure (Anon., 1990). The market sample was subjected for sensory evaluation by 10 panellist from the Dept. of Food Science and Nutrition, Rural Home Science College, University of Agricultural Sciences, Dharwad using 9 point hedonic scale.

Results and discussion

Fig. 1 depicts the types of cereal used for *chakli* recipes. Rice was the most common cereal (86 %), followed by wheat (26 %). Other cereals like jowar (4 %), foxtail millet (2%) and little millet (2 %) were also used for preparation of *chakli*. Similarly, it was also observed from Fig. 2 that the most commonly used pulse was black gram dhal (44 %), followed by bengal gram dhal (38 %), green gram dhal (24 %) and red gram dhal (2 %). The use of rice as a major ingredient may be attributed to the crispiness characteristic, which gives a better texture since the viscosity is not as high in rice when liquid is added like other types of grain flours and form a batter with high degree of solids which act as a buffer in the cooking process to absorb liquids and thus the rice flour batter would produce a dry texture (Bond, 2004). Table 1 indicates the form of cereals used for the preparation of *chakli*. The highest percentage of rice was used in the form of rice flour (36 %) followed by raw rice (16 %), parboiled rice (6%), flaked rice (2 %) and the next common cereal used singly for chakli preparation was maida (14 %) and the least being little

Table 1. Forms of cereals and pulses used in *chakli* recipes N=50

Forms	Number	Percentage
Cereals		
Rice	8	16
Rice flour	18	36
Parboiled rice	3	6
Flaked rice1	1	2
Raw rice +Boiled rice	1	2
Maida	7	14
Rice + Maida	7	14
Maida + Jowar	1	2
Rice + Foxtail millet	1	2
Rice + Jowar + Maida	1	2
Little millet	1	2
Pulses		
Black gram dhal	13	26
Roasted black gram dhal flour	1	2
Green gram dhal	6	12
Green gram dhal paste	1	2
Bengal gram dhal flour	7	14
Puffed bengal gram dhal	3	6
Red gram dhal	1	2
Bengal gram dhal + Black gram dhal	2	4
Bengal gram dhal flour + Black gram dhal flour	2	4
Green gram dhal + Black gram dhal	1	2
Green gram dhal flour + Bengal gram dhal flour	1	2
Roasted black gram dhal flour + Puffed bengal gram dhal	1	2
Bengal gram dhal+ Green gram dhal + Red gram dhal + Black gram dhal	1	2
Bengal gram dhal + Black gram dhal + Green gram dhal	2	4

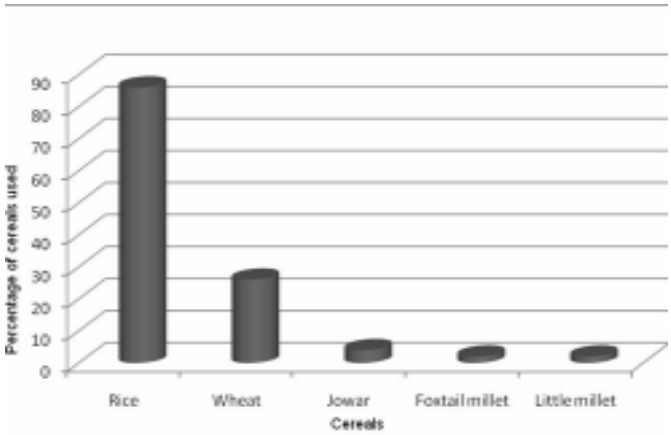

Fig. 1 Types of cereals used in *chakli* recipes

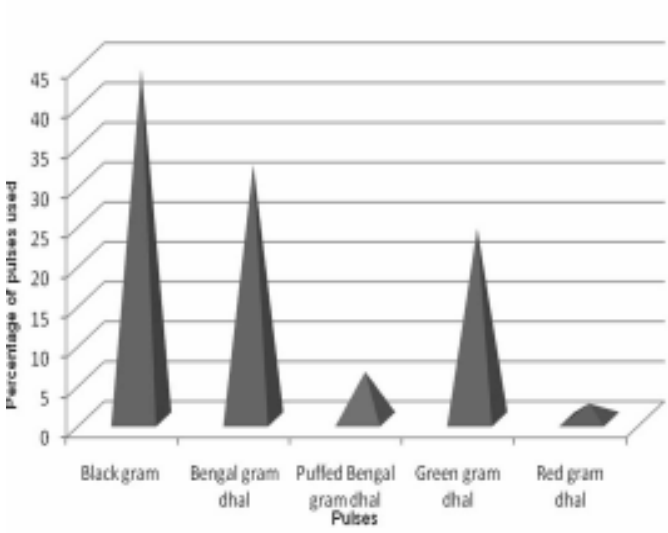

Fig. 2 Types of pulses used in *chakli* recipes

Table 2. Pre-treatments given to cereals and pulses for *chakli* recipes N=50

Pre-treatment	Number	Percentage
Cereals		
Direct usage of rice flour	22	44
Rice flour of soaked dried grains	9	18
Rice flour of washed and dried grains	1	2
Rice flour of roasted grains	3	6
Rice flour of washed, dried and roasted grains	3	6
Flour of boiled rice grain	1	2
Washing, draining and leaving overnight for rice flake	1	2
Maida	5	10
Steaming of maida	7	14
Steaming of maida + rice flour together	2	4
Direct usage of jowar flour	2	4
Direct usage of foxtail millet flour	1	2
Little millet flour of roasted grains	1	2
Pulses		
Direct usage of pulse flour	14	28
Flour of roasted pulses	21	42
Cooking of green gram dhal	7	14
Flour of soaked and dried black gram dhal	1	2

Table 3. Combination of spices used in *chakli* recipes N=50

Spice	Number	Percentage
Cumin	10	20
Cumin + chilli powder	3	6
Cumin + asafoetida	3	6
Asafoetida + chilli powder	3	6
Chilli powder	2	4
Ajwain + chilli powder + turmeric	2	4
Cumin + chilli powder + turmeric	1	2
Cumin seed/ajwain (powdered) + chilli powder	1	2
Ajwain + chilli powder	1	2
Asafoetida	1	2
Asafoetida + chilli powder	1	2
Asafoetida + green chilli	1	2
Turmeric + chilli powder	1	2
Green chilli + corriander	1	2
Cumin + turmeric	1	2
Soda bicarbonate*	1	2
Cumin + ginger-green chilli paste + chilli powder + turmeric powder	1	2
Cumin + ajwain + turmeric + chilli powder	1	2
Cumin + ajwain + asafoetida + chilli powder + coriander powder	1	2
Cumin + ajwain + asafoetida + chilli powder + coriander powder + turmeric powder	1	2
Cumin + asafoetida + chilli powder + coriander powder + turmeric powder	1	2
Cumin + coriander seed	1	2
Cumin + pepper + garlic	1	2
Green chilli + soda bicarbonate*	1	2
Cardamom powder	1	2

*Food additives

millet (2 %). Besides, the combination of rice and maida (14 %), maida and jowar (2 %), rice flour and foxtail millet flour (2 %), rice flour, jowar flour and maida (2 %) were used for *chakli* preparation. Similarly, the form of pulse used were black gram dhal (26 %), roasted black gram dhal flour (2 %), green gram dhal (12 %), green gram dhal paste (2 %), bengal gram flour (14 %), puffed bengal gram dhal (6 %) and tur dhal (2 %). The combination of pulses used for *chakli* preparation were roasted black gram dhal flour with puffed bengal gram dhal (2 %), black gram flour with bengal gram flour (2 %), bengal gram dhal, green gram dhal, tur dhal and black gram dhal (2 %), green gram dhal and black gram dhal (2 %), bengal gram dhal, black gram dhal and green gram dhal (2 %), bengal gram dhal, black gram dhal and green gram dhal (4 %), bengal gram dhal flour and black gram dhal flour (2 %), green gram dhal flour and bengal gram dhal flour (2 %). Addition of pulses not only enhances the nutritive value and sensory attributes but also improves the appearance and extrusion quality due to its water and fat binding capacity (Boye *et al.*, 2010).

The most common pre-treatments given to cereals and pulses were soaking, roasting, steaming and cooking (Table 2). The most common types of pre-treatment given for rice were soaking (18%) , washing and drying (2%), roasting (6%), washing, drying and roasting (6%), boiling (2 %), washing, draining and leaving overnight for rice flakes (2%). Steaming was the pre-treatment given to maida (14 %) and wheat flour (14 %), Where as roasting was done to little millet (2 %). The most common pre-processing methods employed for pulses were roasting (38%), cooking of green gram dhal (14 %) and soaking and drying of black gram dhal. Pre-treatment improves the flour quality by enhancing the flavour, partial gelatinization, reduction in cooking time and quick absorption of fat (Geethlakshmi and Prakash, 2000). Use of wheat in *chakli* preparation may be due to the presence of gluten which improves the textural quality of

Table 4. Types of fats and oils used for shortening in *chakli* recipes N=50

Shortening used	Number	Percentage
Butter	22	44
Oil	4	8
Ghee	3	6
Not mentioned	21	42

Table 5. Other ingredients used in *chakli* recipes N=50

Ingredients	Number	Percentage
Sesame	26	52
Coconut grating	4	8
Potato	3	6
Coconut milk	2	4
Milk	2	4
Sago	1	2
Ground nut	1	2
Egg	1	2
Curd	1	2
Cream	1	2
Coconut whole	1	2
Jaggery	1	2

Table 6. Evaluation of commercial *chakli* available in Dharwad local market

Main ingredients	Colour	Size	Cost/ 100g (₹)	Brand name
Rice	Dark brown	Large	12	Unbranded
Rice	Golden brown	Large	12	Unbranded
Rice	Golden brown	Small	15	Unbranded
Rice	Golden brown	Small	16	Unbranded
Rice	Golden brown	Small	20	Unbranded
Rice	Light golden brown	Medium	15	Unbranded
Rice	Golden brown	Large	25	Unbranded
Rice and palak with colourant (green)	Dark green	Small	15	Unbranded
Rice and palak	Green	Small	15	Unbranded
Rice	Golden brown	Small	15	Unbranded
Rice and ragi	Light brown	Small	15	Unbranded
Rice with pulse mix	Golden brown	Large	20	Unbranded
Rice with palak	Green	Large	20	Unbranded
Rice and ragi	Light brown	Large	20	Unbranded
Rice	Golden brown	Large	25	Unbranded
Rice	Golden brown	Large	25	Udupinayak
Rice and palak	Green	Large	25	Udupinayak
Rice and palak	Green	Large	25	UdupiVinayak
Rice with masala	Golden brown	Large	23	UdupiPrabhu
Rice and pulse mix	Wheatish brown	Large	30	Tasty World
Rice	Golden brown	Large	30	Tasty World
Rice and pulse mix (low fat *chakli*)	Wheatish brown	Large	32	Charlie
Rice and Black gram (low fat *chakli*)	Golden brown	Large	32	Charlie

the product. The advantage of addition of other processed cereals and millets may be attributed for better crispier products with less shortening (Narasimha *et al*., 1974).

The most common spice used in *chakli* recipes was cumin (52 %) followed by chilli powder (40%), asafoetida (28%), turmeric (24 %) and ajwain (16 %) as furnished in Table 3. Spices were used singly or in combination. Cumin (20 %) and asafoetida (2 %) were used singly, while in other recipes, spices were used in combination of two or more spice mix (Table 3). This is well known fact that spices add flavour and improves the taste. Similarly, in most of the Indian recipes it was observed that use of more spices and in different combination produces diversified recipes. Besides, it was observed that food additive like soda bicarbonate (4 %) was also used.

The most common shortening used in preparation of *chakli* was butter (44%), followed by oil (8%) and ghee (6%) while in the other 42 recipes, the shortening used was not mentioned (Table 4). The textural quality of fried products is known to be influenced by use of shortening. It functions as lubricants as well as provides a crispier texture (Bhattacharya and Narasimha, 2008).

The other ingredients occasionally used in *chakli* preparation (Table 5) were sesame (52 %), coconut grating (8%), potato (6%), coconut milk (4%), milk (4%), sago (2 %), ground nut (2%), egg (2%),), curd (2%), cream (2%), whole coconut (2%) and jaggery (2%). Addition of other ingredients may result in product with higher nutritive content than snacks with 'empty calorie'. Most snacks are poor source of proteins and

Table 7. Quality parameters of commercial *chakli*

Sample	Diameter (mm)	Height (mm)	Weight of individual *chakli* (g)	Density (g/cm^3)	Moisture (%)	Fat (%)
A	165.85 ± 4.0*	6.15 ± 0.67	32.51± 1.77	0.74 ± 0.00	4.80 ± 0.08	42.13 ± 0.33
B	99.06 ± 2.70	5.16 ± 0.32	26.06 ± 0.22	0.77 ± 0.00	4.88 ± 0.25	42.17 ± 0.76
C	36.22 ± 2.49	6.88 ± 1.01	2.95 ± 0.49	0.73 ± 0.01	3.45 ± 0.19	17.27 ± 0.17
D	42.70 ± 2.85	12.08 ± 0.42	3.08 ± 0.32	0.77 ± 0.01	4.68 ± 0.12	17.91 ± 0.03
E	42.92 ± 5.00	9.92 ± 0.25	2.45 ± 0.22	0.79 ± 0.00	4.78 ± 0.14	26.49 ± 0.45
F	62.70 ± 4.37	6.06 ± 0.35	5.69 ± 0.39	0.77 ± 0.00	3.81 ± 0.04	26.95 ± 0.33
G	68.60 ± 3.96	9.15 ± 0.233	16.22 ± 0.85	0.77 ± 0.00	4.72 ± 0.24	42.25 ± 0.00
H	65.49 ± 4.98	6.03 ± 0.47	2.93 ± 0.71	0.77 ± 0.01	3.00 ± 0.20	42.26 ± 0.62
I	46.00 ± 2.15	5.24 ± 0.50	3.30 ± 0.07	0.78 ± 0.01	4.50 ± 0.01	29.26 ± 0.04
J	68.60 ± 2.33	4.69 ± 0.07	16.77 ± 0.23	0.79 ±0.01	4.42 ± 0.14	30.13 ± 0.60
S.Em. ±	4.22	0.02	0.17	1.27	0.003	0.02
C.D. at 5 %	12.46	0.07	0.49	3.72	0.01	0.06

* Values are Mean ± Standard deviation of triplicate

Table 8. Sensory profile of commercial *chakli*

Sample No.	Appearance	Colour	Texture	Taste	Over all acceptability
1	4.4 ± 2.46	3.78 ± 2.10	5.9 ± 2.00	4.0 ± 2.26	3.6 ± 1.90
2	7.9 ± 1.60	7.56 ± 1.25	5.9 ± 1.17	7.7 ± 1.42	7.8 ± 1.32
3	6.2 ± 1.47	5.89 ± 2.56	5.3 ± 1.79	6.0 ± 2.21	5.6 ± 2.41
4	5.6 ± 1.78	5.33 ± 2.17	5.3 ± 2.26	5.1 ± 2.33	5.2 ± 2.04
5	5.7 ± 2.06	5.22 ± 2.01	6.0 ± 2.27	5.4 ± 2.50	5.3 ± 2.54
6	5.8 ± 1.93	5.11 ± 2.04	6.6 ± 2.11	4.9 ± 2.23	5.2 ± 1.87
7	6.0 ± 2.45	6.00 ± 1.93	7.3 ± 2.41	6.3 ± 2.06	6.5 ± 2.37
8	6.1 ± 2.13	6.00 ± 2.15	5.9 ± 2.18	6.0 ± 2.26	6.0 ± 2.26
9	6.4 ± 1.90	6.11 ± 2.05	5.6 ± 2.13	5.7 ± 2.45	5.5 ± 2.22
10	6.5 ± 1.84	6.22 ± 2.04	5.3 ± 2.39	5.9 ± 2.38	6.0 ± 2.16
11	5.4 ± 2.72	4.67 ± 2.22	6.9 ± 2.41	4.6 ± 2.27	4.7 ± 2.21
12	5.1 ± 2.28	5.22 ± 2.33	3.1 ± 2.11	5.2 ± 2.30	4.8 ± 2.20
13	7.4 ± 1.26	7.00 ± 2.11	6.2 ± 2.23	7.0 ± 2.05	7.5 ± 1.43
14	4.0 ± 2.40	4.00 ± 2.16	5.1 ± 1.66	3.8 ± 2.20	3.2 ± 1.87
15	5.8 ± 2.10	5.67 ± 2.01	6.6 ± 2.28	5.4 ± 2.17	5.2 ± 1.55
16	7.0 ± 1.60	6.67 ± 1.23	6.6 ± 1.97	6.8 ± 2.20	7.1 ± 1.20
17	7.0 ± 2.40	6.11 ± 2.32	6.1 ± 2.50	6.1 ± 2.28	6.4 ± 1.90
18	7.4 ± 1.58	7.11 ± 0.88	5.5 ± 1.49	7.0 ± 1.05	7.2 ± 1.03
19	6.6 ± 1.58	6.44 ± 1.18	4.3 ± 1.41	5.9 ± 1.60	5.9 ± 1.45
20	5.5 ± 2.64	4.89 ± 2.20	5.6 ± 1.85	5.6 ± 1.65	5.3 ± 2.00
21	6.2 ± 1.93	5.56 ± 1.91	4.1 ± 1.96	5.6 ± 1.78	5.7 ± 1.77
22	4.3 ± 2.16	4.11 ± 1.97	4.6 ± 1.91	3.9 ± 1.52	3.8 ± 1.69
23	5.6 ± 2.36	5.22 ± 2.20	7.6 ± 1.90	4.3 ± 1.83	4.2 ± 1.75
S.Em.±	0.43	0.43	0.43	0.43	0.40
C.D at 5%	1.20	1.21	1.19	1.21	1.11

Values are mean ± Standard deviation by 10 panellists

other micronutrients. This also reflects the importance given to local ingredients for enriching the recipes by our ancestors.

Among the commercial *chakli* samples, only 8(35%) were branded and remaining (65%) were locally prepared. The cost of the samples ranged between ₹ 15 to 32 per 100g depending on branded and unbranded product, where branded product cost was more than the local, unbranded products (Table 6). Fifty per cent of commercial *chakli* were golden brown in colour. *Chakli* were also available in green, whitish brown and light brown colour. The variation in the colour is due to the type of ingredients used (Table 6). Sixty five per cent of *chakli* were available in larger size. Geethalakshmi and Prakash (2000) reported that 92 per cent of the households in the residential areas of Mysore city prepare *chakli* at household level. Whereas 93.33 per cent of the women entrepreneurs were found to prepare *chakli* in Dharwad city (Ninganagoudar, 2010).

There was a significant ($p = 0.05$) variation in the randomly selected ten commercial *chakli* (Table 7). The diameter of *chakli* varied from 36.22-165.85 mm, height 4.69-12.02 mm, weight 2.45-32.5 g and density 0.73- 0.79 g/cc^3. Similarly, moisture content ranged from 3.0 to 5.8 per cent as the collected sample differed in their nature of preparation and fat content ranged from 17.27 per cent to 42.26 per cent indicating that commercial *chakli* varied greatly in terms of physico-chemical characters.

The sensory scores of the market samples of *chakli* are presented in Table 8. The sensory scores varied from 4.00-7.90, 4.00- 7.56, 3.10-7.60, 3.8-7.7 and 3.20-7.80, respectively for appearance, colour, texture, taste and overall acceptability. The results also showed that 52, 43, 39, 35, and 34 per cent of the *chakli* were below the acceptable range for appearance, colour, texture, taste and overall acceptability, respectively. The variation in sensory profile is due to the use of non optimised recipes at household level and they are available commercially as non branded (65%). Geethalaxmi and Prakash (2000) observed wide variation in *chakli* prepared at household level and variation was for ingredients and thermal treatment of flour.

It was observed from the study that *chakli* is a mixture of wide range of ingredients. The variation in commercial *chakli* for nutrients and sensory attributes needs attention for optimisation of the product for sustainable quality.

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