

# CHARACTERISTICS OF POTATO CHIPS OF DIFFERENT VARIETIES

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**Abstract:** Moisture content of varieties differed significantly ( $p \leq 0.01$ ) ranging from 78.87 per cent to 84.53 per cent with lowest in Atlanta and thus ranked first. Variety Kufri Khayti (20.93 mg/100g) showed highest dry matter content. Starch of potato tubers and it ranged between 58.32 per cent to 85.67 per cent with highest content in Kufri Khayti and lowest in Kufri Surya. Among the varieties Kufri Pukhraj had lowest reducing sugars (55.13 mg/100g), whereas lowest non reducing and total sugar in J/99-242 with 104.43 mg/100g and 216.10 mg/100g respectively. Compared to control variety, chips prepared from Kufri Khayti found to be more crunchy, possessed firm texture as well as appealing flavour, appearance and overall acceptability. The acceptability scores was highest for potato chips from Kufri Khayti (88.89 %) followed by Kufri Surya (80.44 %). There was a negative relationship between reducing sugar and colour score as well as moisture content and texture score, whereas positive relation between dry matter and sensory parameter.

**Keywords:** Chemical, Chips, Potato

## INTRODUCTION

Potato is an important crop not only of the developed countries but also of the developing countries. Large portion of potatoes produced are consumed in processed form in developing countries. In the United States of America about 57% of the total produce is processed (Ezekiel *et al.*, 1999). Whereas in India less than 0.3% of the total produce is processed (Ezekiel *et al.*, 2002). Potatoes currently have the highest rate of production growth in most of the developing countries and the mail stay in the diet of people in many parts of the world. Indian snack industries use potatoes for producing products like potato chips, potato sticks, alu bhujia, puffed potatoes, potato powder, potato flakes and French fries potatoes. Production of potato chips has been increasing steadily each year and hence potato industry is growing steadily. The potato chips business is increasing at a rate of 10-12 per cent each year, consuming over 34 per cent of the total processed volume of potato. People now feel the need of ready-to-eat foods which are not only attractive and appetizing but rich in calories (Sethi and Malhan 1987).

## MATERIAL AND METHOD

The study was carried at UAS dharwad a total of ten potato cultivars viz., Kufri Chipsona - 2, Atlanta, Kufri Surya, Kufri Pukhraj, Kufri Khayti, Kufri Jyoti, Kufri Pushkar, Kufri Bahar, Kufri Ashoka and J/99-242 grown in AICRP, Kumbapur were used for preparation of chips and were analysed for different chemical attributes. Tubers were cut, mixed thoroughly and used for different chemical analysis; total sugar, reducing sugar and non reducing sugar was estimated by Nelson Somogyi method (Sadasivam and Manickham 1992). Moisture and dry matter content (Anon., 1970) and starch (Sadasivam and Manickham 1992). Chips from fresh tubers were

prepared as per standard procedure given by CPRI, Shimla (Marwaha *et al.*, 2008). Organoleptic evaluation of processed potato products potato chips was carried out by 10 trained panellists of Dept. of Food Science and Nutrition using nine point hedonic scales. Total score (M) with maximum score of 45, was calculated as mentioned below

$$\text{Total score (M)} = m_1 + m_2 + m_3 + m_4 + m_5$$

Acceptability Index (%) of potato chips was calculated using total scores as given below

$$\text{Acceptability Index} = \frac{\text{Total score}}{\text{Maximum score (45)}} \times 100$$

CRD (complete randomized design) single factor was used to study the variance. The relation between chemical parameters and sensory profile was verified by correlation using SPSS (Statistical package for social science) software. Ranking of variables was done with Duncan Multiple Range test (DMRT) using M stat software.

## RESULT AND DISCUSSION

Moisture content of varieties differed significantly ( $p \leq 0.01$ ) ranging from 78.87 per cent to 84.53 per cent with lowest in Atlanta and thus ranked first (Table 1). Compared to control, most of the varieties showed high level of moisture content these differences could be attributed to the development and anatomy of the tuber (Reeve *et al.*, 1970). Because of low moisture content, the varieties like Atlanta, Kufri Chipsona-2, Kufri Surya, Kufri Khayti and Kufri Pukhraj are suitable for processing as they absorb less oil during frying. Variety Kufri Khayti (20.93 mg/100g) with highest dry matter ranked first followed by Atlanta, Kufri Surya and Kufri Chipsona-2 as they had significantly ( $p \leq 0.01$ ) high dry matter compared to others and were ideal for chips preparation. Dry matter content of 20.5 per cent in Kufri Chipsona-2 is on par with the findings reported by Singh *et al.* (2008) and Das *et al.* (2001),

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The difference in dry matter content among the cultivars could be due to variation in hereditary factors, agro-climatic conditions as well as agronomic practices followed for raising the crop (Singh *et al.*, 2008; Sood *et al.*, 2008; Talburt and Smith, 1975; Lisinska and Leszczynski, 1989; Abong *et al.*, 2010; Kumar *et al.*, 2003).

Starch is the major constituent of potato tubers and it ranged between 58.32 per cent to 85.67 per cent with highest content in Kufri Khayti and lowest in Kufri Surya. The values fall within the range reported by Sood *et al.* (2008). The difference in starch content and its component among the cultivars may be due to difference in morphology of tubers and internal distribution of nutrients (Kroner and Volksen, 1950; Talburt and Smith, 1975). Except for Kufri Pushkar, all other varieties had less than 0.1 per cent of reducing sugars thus were suitable for preparation of fried products. Among the varieties Kufri Pukhraj had lowest reducing sugars (55.13 mg/100g) and thus ranked first. The reducing sugars for Kufri Chipsona-2 (83.28 mg/100g) and Kufri Pukhraj (158.6 mg/100g) reported by Sood *et al.* (2008) is in contrast to the present investigation, which may be attributed to environmental factors, different growing seasons and fertilizers used (Talburt and Smith, 1975; Lisinska and Leszczynski, 1989).

Sood *et al.* (2008) reported total and non reducing sugars of 110.89 mg/100g and 27.64 mg/100g respectively for Kufri Chipsona-2, while Kufri Pukhraj recorded 556 mg/100g and 158.61 mg/100g of total and non reducing sugars respectively which are comparatively less than the present study. The variation in sugar content in the present study could be due to size difference, change in weather conditions during growth or difference in rate of plant maturity and fluctuation of nutrients in plant system (Sood *et al.*, 2008; Singh *et al.*, 2008; Abong *et al.*, 2010; Talburt and Smith, 1975; Lisinska and Leszczynski, 1989).

The sensory attributes of potato crisps that were evaluated differed significantly ( $P \leq 0.01$ ) among the cultivars (Table 2). Colour/appearance were most appealing in Kufri Khayti and very less in Kufri Pushkar. The variation among the cultivars could be due to difference in sugar content, organic acids, pH, and trace metals such as iron or manganese (Bohart and Carson, 1955; Lisinska and Leszczynski, 1989; Goel *et al.*, 2007). The desirable flavour of chips is limited by the high dry matter, starch in raw potato tubers as well as the low sugar content. The flavour perception significantly ( $P \leq 0.01$ ) varied among the cultivars which may be due to pyrazines as it is positively correlated to the organoleptic parameters in potato chips (Maga and Sizer, 1973). The low

score for flavour exhibited by Kufri Pushkar may be due to dark brown colour resulted from burnt chips. Chip texture is connected with the dry matter content of raw potato tubers. Chips from potatoes with high dry matter ( $>25\%$ ) can exhibit hard texture (Lisinska and Leszczynski, 1989). Textural scores differed significantly ( $P \leq 0.01$ ) among the cultivars in the present investigation, which could be due to difference in amount of dry matter content. Depending upon the tuber characteristics especially dry matter and processing conditions, the texture can be too hard or too soft (soggy). Apart from starch content, non starch polysaccharides, pectin play most important role in shaping crisp texture (Kita, 2002) and it can be one of the reason for undesirable texture reported by Kufri Ashoka though it had high starch content (65.7%). The appearance, texture, flavour and over all acceptability of the chips of Kufri Khayti were the best and thus ranked first which is directly linked to high dry matter (texture) and low reducing sugars (colour). Compared to control variety, chips prepared from Kufri Khayti found to be more crunchy, possessed firm texture as well as appealing flavour, appearance and overall acceptability. Difference in sensory characteristics among the varieties could be attributed to variation in level of distribution of chemical composition or individual differences in perception of sensory parameters. The acceptability scores was highest for potato chips from Kufri Khayti followed by Kufri Surya (Table 3) which could be due to varietal differences and which is the major factor. Least acceptability scores for Kufri Ashoka could be due to high moisture content that affected the texture. A correlation study revealed that increase in reducing sugars darkened the chip colour (Table 4) and is on par with the results reported by (Habib and Brown, 1957; Abong *et al.*, 2010; Ezekiel *et al.*, 2003). Increase in dry matter content of potatoes increased all sensory scores and thus Kufri Khayti with high content of dry matter ranked first for all sensory parameters. Starch content showed positive relation with texture and is on par with the results reported by Kita (2002), whereas higher content of moisture in raw potatoes showed lower textural scores and vice versa which could be the reason for low textural scores for chips from Kufri Ashoka. Thus chips prepared from Kufri Khayti was most acceptable with high acceptability index (88.89 %) followed by Kufri Surya (80.44 %). There was a negative relationship between reducing sugar and colour score as well as moisture content and texture score, whereas positive relation between dry matter and sensory parameter.

**Table 1.** Chemical composition of different potato varieties.

Sl. No.	Variety <sup>#</sup>	Total sugars <sup>y</sup>	Reducing sugars <sup>y</sup>	Non reducing sugars <sup>y</sup>	Moisture	Dry matter	Starch <sup>y</sup>
1	K.Chipsona-2	686.67±0.58 <sup>g</sup>	111.67±11.55 <sup>g</sup>	575.00±11.27 <sup>g</sup>	79.47±0.12 <sup>a</sup>	20.57±0.06 <sup>a</sup>	72.30±0.52 <sup>c</sup>
2	Atlanta	500.00±0.58 <sup>d</sup>	90.33±10.00 <sup>e</sup>	409.67±10.50 <sup>d</sup>	78.87±0.58 <sup>a</sup>	20.70±0.17 <sup>ab</sup>	73.32±1.87 <sup>d</sup>

3	K. Surya	520.00±0.64 <sup>e</sup>	60.73±8.66 <sup>b</sup>	459.27±8.99 <sup>e</sup>	79.33±0.12 <sup>a</sup>	20.67±0.12 <sup>ab</sup>	62.70±1.04 <sup>d</sup>
4	K. Pukhraj	506.67±0.64 <sup>de</sup>	55.13±2.89 <sup>a</sup>	451.53±2.63 <sup>e</sup>	80.67±1.15 <sup>b</sup>	19.77±0.32 <sup>c</sup>	64.96±1.62 <sup>d</sup>
5	K. Khayti	216.67±1.15 <sup>a</sup>	75.90±5.77 <sup>c</sup>	140.77±6.90 <sup>b</sup>	79.00±0.20 <sup>a</sup>	20.93±0.12 <sup>a</sup>	85.67±1.57 <sup>a</sup>
6	K. Jyoti	816.67±0.64 <sup>h</sup>	104.77±15.28 <sup>f</sup>	711.90±15.17 <sup>h</sup>	82.00±0.00 <sup>c</sup>	18.00±0.00 <sup>d</sup>	65.98±2.68 <sup>d</sup>
7	K. Pushkar	398.07±1.33 <sup>c</sup>	210.33±16.05 <sup>h</sup>	187.73±15.43 <sup>c</sup>	84.53±0.92 <sup>d</sup>	15.63±0.25 <sup>f</sup>	68.37±2.82 <sup>c</sup>
8	K. Bahar	305.53±1.27 <sup>b</sup>	104.03±5.55 <sup>f</sup>	201.50±4.49 <sup>c</sup>	83.93±0.12 <sup>d</sup>	16.07±0.12 <sup>e</sup>	71.43±3.44 <sup>c</sup>
9	K. Ashoka	569.40±2.54 <sup>f</sup>	87.33±12.73 <sup>d</sup>	482.07±12.50 <sup>f</sup>	84.33±0.23 <sup>d</sup>	15.67±0.12 <sup>f</sup>	65.70±1.56 <sup>c</sup>
10	J/99-242	216.10±0.58 <sup>a</sup>	111.67±2.42 <sup>g</sup>	104.43±2.76 <sup>a</sup>	84.07±0.81 <sup>d</sup>	15.30±0.10 <sup>g</sup>	52.55±2.06 <sup>e</sup>
	F	30*	55*	65*	40*	69*	53*
	S.Em.±	5.89	0.67	5.85	0.33	0.09	1.19
	CD(0.01)	17.37	1.97	17.24	0.98	0.89	3.51

#Mean of 3 replications, \* Significant at 0.01 level, <sup>y</sup> dry weight basis. Mean ± S.D., Different superscripts within a column indicate significant difference at 0.05 level by DMRT.

**Table 2.** Organoleptic profile of potato chips from different varieties

Sl. No.	Variety <sup>#</sup>	Appearance	Texture	Flavour	Taste	Overall acceptability
1	KCchipsona-2	5.4±1.51 <sup>cde</sup>	6.9±1.29 <sup>abcd</sup>	6.9±1.20 <sup>ab</sup>	6.8±1.14 <sup>ab</sup>	6.1±1.37 <sup>bcd</sup>
2	Atlanta	6.4±1.71 <sup>bc</sup>	5.4±1.96 <sup>c</sup>	6.4±0.97 <sup>ab</sup>	6.1±0.86 <sup>abc</sup>	5.9±0.88 <sup>cde</sup>
3	K. Surya	7.0±1.05 <sup>ab</sup>	7.5±0.97 <sup>ab</sup>	7.3±1.16 <sup>a</sup>	7.2±1.03 <sup>a</sup>	7.2±1.03 <sup>ab</sup>
4	K. Pukhraj	7.8±0.79 <sup>a</sup>	5.8±1.68 <sup>de</sup>	5.6±1.58 <sup>bc</sup>	5.5±1.58 <sup>c</sup>	6.4±1.17 <sup>bcd</sup>
5	K. Khayti	8.0±0.82 <sup>a</sup>	7.8±0.92 <sup>a</sup>	7.4±1.07 <sup>a</sup>	7.3±0.95 <sup>a</sup>	7.7±0.82 <sup>a</sup>
6	K. Jyoti	7.1±0.88 <sup>ab</sup>	7.2±0.79 <sup>abc</sup>	7.3±0.95 <sup>a</sup>	7.3±0.95 <sup>a</sup>	7.1±0.55 <sup>abc</sup>
7	K. Pushkar	4.1±2.13 <sup>e</sup>	6.7±1.64 <sup>abcde</sup>	4.9±1.80 <sup>c</sup>	5.3±1.64 <sup>c</sup>	4.8±1.69 <sup>ef</sup>
8	K. Bahar	5.9±1.52 <sup>bcd</sup>	6.1±1.10 <sup>cde</sup>	6.1±1.37 <sup>abc</sup>	6.1±1.66 <sup>abc</sup>	6.0±1.42 <sup>bcd</sup>
9	K. Ashoka	5.7±1.49 <sup>bcd</sup>	2.7±1.25 <sup>f</sup>	4.8±1.40 <sup>c</sup>	3.9±1.52 <sup>d</sup>	4.0±1.42 <sup>f</sup>
10	J/99-242	4.7±1.89 <sup>de</sup>	6.2±1.23 <sup>bcd</sup>	5.6±1.71 <sup>bc</sup>	5.9±1.37 <sup>bc</sup>	5.4±1.43 <sup>de</sup>
	F-value	7.8*	12.1*	5.3*	6.7*	8.3*
	S.Em.±	0.46	0.49	0.43	0.41	0.39
	CD(0.01)	1.29	1.18	1.2	1.16	1.1

# 9 point Hedonic scale \* Significant at 0.01 level, Mean ± S.D., Different superscripts within a column indicate significant difference at 0.05 level by DMRT.

**Table 3.** Acceptability indices of potato chips

Sl. No.	Varieties	Total scores (Max 45)	Acceptability index (%)	Rank
1	K. Chipsona-2	32.10	71.00	IV
2	Atlanta	30.20	67.16	V1
3	K. Surya	36.20	80.44	II
4	K. Pukhraj	31.10	69.11	V
5	K. Khayti	38.20	84.89	I
6	K. Jyoti	36.00	80.00	III
7	K. Pushkar	25.80	57.33	IX
8	K. Bahar	30.20	67.11	VII
9	K. Ashoka	21.10	46.89	X
10	J/99-242	27.80	61.78	VIII

**Table 4.** Correlation (r) between chemical composition (%) of raw potatoes with organoleptic parameters of potato chips

Sl. No.	Parameters	Total sugars (mg)	Reducing sugars (mg)	Non reducing sugars (mg)	Dry matter (g)	Starch (g)	Moisture (g)
1	Appearance	0.399	-0.793**	0.342	0.687*	0.677**	-0.657*
2	Texture	0.528	0.084	0.412	0.650*	0.670*	-0.700**
3	Flavour	0.636	-0.435	0.525	0.728*	-0.100	-0.740*
4	Taste	0.602	-0.225	0.473	0.618	-0.192	-0.712*
5	Overall acceptability	0.639	-0.485	0.508	0.717*	-0.113	0.350

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