



## Research Article

# Nutritional Value with Quality of Late Season Cauliflower Varieties in Terai Region of Nepal

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### Abstract

An experiment was carried out to assess the nutritional value along with quality of curds in late season cauliflower varieties at Rampur, Chitwan during November 2017 to March, 2018. The eleven late season cauliflower varieties were Freedom, Titan, Ravella, Amazing, Artica, Bishop, Casper, Indam 9803, NS 106, Snow Mystique and Snowball 16 which were introduced from USA, Europe, India and Nepal. The experiment was prepared in a Randomized Complete Block Design (RCBD) with four replications. The main objective of this study was to check the nutritional content, taste, compactness, appearance and freshness of the curds in eleven late season cauliflower varieties at Rampur, Chitwan. Nutritional value along with taste quality, compactness, appearance and freshness of the curds were measured after harvest. Maximum moisture and carbohydrate content was found in Freedom while higher crude fat was obtained in Titan and Bishop. Similarly, higher crude protein and crude fiber was found in NS 106. Significantly better taste score (8.8) was found in Snowball 16 than other varieties. Better compactness score of curd was found in Artica and Titan than other varieties. Significantly better appearance score (8.0) was found in Artica but poor appearance score was found in Casper than other varieties. At different intervals after harvesting of curds, significantly fresher curds were found in Artica than other varieties. In conclusion, NS 106 performed higher content of crude protein and crude fiber while Snowball 16 executed better tasty curds than other varieties. Artica also showed better performance on freshness of curds than other varieties.

**Keywords:** Cauliflower; late season; nutrition value; postharvest, quality

### Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the popular winter season vegetable crops among the cole crops. It has highest share of 14.6% in the total vegetable crop production and also highest share of 13% in the total vegetable cultivated area of Nepal (MoAD, 2018). Cauliflower is also a rich source of vitamins and different

minerals which strengthens immune system of the body if used regularly (Keck, 2004). Edible part of the cauliflower are consumed as cooking vegetables and widely used in preparing chaumin, burger, sandwich in the restaurants (Ashraf *et al.*, 2017). It is also consumed as salad and pickles (Kabiraj *et al.*, 2017)

Cauliflower is highly sensitive to climatic factors (Nath et al., 1987) which influences on growth and development of the curds. In late winter season, fuzzy, riceyness and loose cauliflower curds were produced due to higher temperature above 24°C (Fujime, 1983; Swiader *et al.*, 1992). Appropriate temperature for curd formation in winter season is 14°C-20°C (Swiader *et al.*, 1992; Baloch, 1994).

In Nepal, the most of the commercial varieties of cauliflower are imported from developed countries as F1 hybrids. Open pollinated varieties of cauliflower during late winter season from November to March are not available in Nepal. The farmers are still using inappropriate varieties which have resulted in lower yield and poor postharvest quality (HRD, 2006). Poor curd development and unfavorable postharvest quality has been seen during late winter season due to higher temperature (Bose and Som, 1993). Thus, a field research was conducted to assess the postharvest quality in late season cauliflower varieties from November 2017 to March 2018 at Horticulture farm of Agriculture and Forestry University, Rampur, Chitwan.

## Materials and Methods

A research on postharvest assessment of eleven late season cauliflower varieties was conducted at Horticulture Farm of Agriculture and Forestry University, Rampur, Chitwan, in Terai region of Nepal. This research was carried out during November 2017 to March 2018 to access the nutritional value, taste quality, compactness, appearance and freshness of the curds in eleven late season cauliflower varieties in Rampur, Chitwan.

### Weather Parameters of The Experimental Area

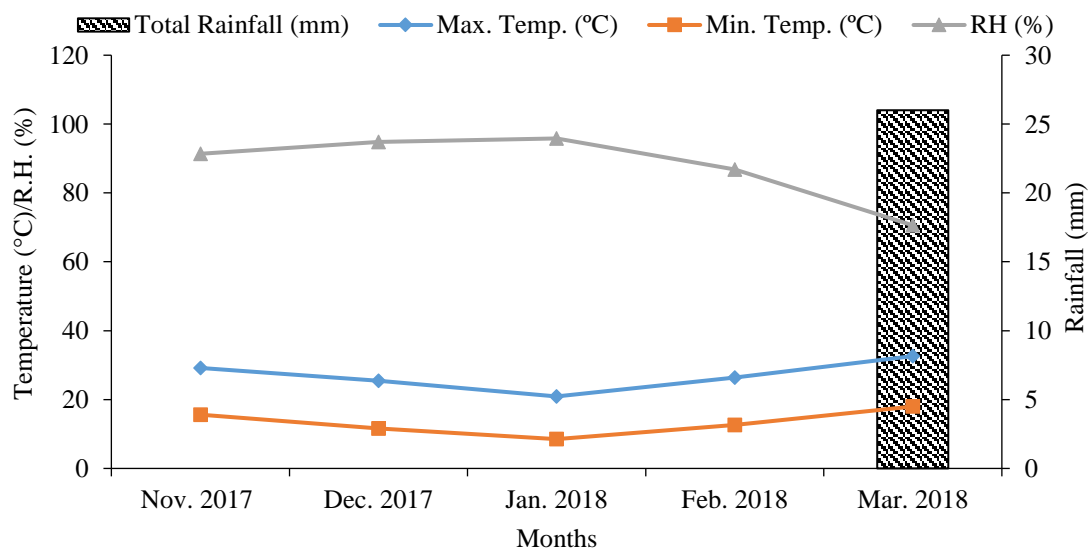
Weather parameters such as temperature, rainfall and relative humidity (RH) was collected from the National Maize Research Program, Rampur Chitwan. The data was taken from cauliflower growing period from November

2017 to March 2018. The maximum temperature of 33°C was recorded in March 2018 but the minimum temperature of 9°C was observed in January 2018. Similarly, the maximum and minimum relative humidity of 96% and 71% was recorded during January and March, 2018 respectively. There was negligible rainfall for whole experiment period at Rampur, Chitwan (Fig. 1).

### Experiment Design and Treatments

The experiment was adjusted in a Randomized Complete Block Design (RCBD) with four replications to eleven late season cauliflower varieties viz. Freedom, Titan, Ravella, Amazing, Artica, Bishop, Casper, Indam 9803, NS 106, Snow Mystique and Snowball 16. The area of individual plot was 7.5 m<sup>2</sup> (3 m x 2.5 m) with 25 plants. Row to row distance was 60 cm and plant to plant distance was 50 cm. The varieties used in this experiment are listed in Table 1.

The seedlings were transplanted at the main field when the seedlings were ready for transplanting. Regular water was provided until the establishment of seedlings at main field. Based on recommended dose of fertilizers, 22.5 kg FYM, 195 g DAP, 152 g urea, 100 g MoP and 10 g borax per plot was provided during the time of field preparation as a basal dose and 98 g urea was supplied 40 days after transplanting as a split dose. Nutritional value along with taste quality, compactness, appearance and freshness of the cauliflower curds were measured from those randomly selected five plants of each plot after harvest. Data were recorded and entered into MS-Excel 2016. The analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) was calculated by using GenStat 18<sup>th</sup> edition. The significant differences between eleven varieties were determined by using the least significant difference (LSD) test at 1% or 5% level of significance (Gomez and Gomez 1984; Shrestha, 2019).



**Fig. 1:** Weather condition during cauliflower growing period from November 2017 to March 2018 at Rampur, Chitwan

**Table 1:** List of late season cauliflower varieties at Rampur, Chitwan during November 2017 to March 2018

Varieties	Source	Variety type
Freedom	Park seed, USA	Hybrid
Titan	Osborne seed, USA	Hybrid
Ravella	Osborne seed, USA	Hybrid
Amazing	Territorial seed company, USA	Open pollinated
Artica	Stokes seeds, New York, USA	Hybrid
Bishop	Rijk Zwaan, Netherlands	Hybrid
Casper	Rijk Zwaan, Netherlands	Hybrid
Indam 9803	Indo-American hybrid seed, India	Hybrid
NS 106	Namdhari seeds Pvt. Ltd., India	Hybrid
Snow Mystique	Takii seed, Japan (Available in Nepal)	Hybrid
Snowball 16	Vegetable seed production center, Dolpa	Open pollinated

## Results and Discussion

### *Nutritional Value of Cauliflower Curds*

Freedom, Ravella, Bishop and NS 106 obtained higher moisture content than mean value (6.9%). Similarly, Titan, Ravella, Amazing and Snowball 16 found higher crude fat content than mean value (2.4%). Higher crude protein was found in Titan, NS 106, Snow Mystique and Snowball 16 than mean value (18.8%). Titan, Amazing, Artica, Indam 9803, Snow Mystique and Snowball 16 found higher total ash content than mean value (7.9%). Similarly, Amazing, Bishop, Indam 9803, NS 106 and Snowball 16 found higher crud fiber than mean value (7.8%). Higher carbohydrate content was found in Freedom, Ravella, Casper than mean value (56.3%). Maximum calcium content was found in Freedom, Titan, Ravella, Amazing, Snow Mystique and Snowball 16 than mean value (97.8 mg/100 g) (Table 2).

### *Taste, Compactness and Appearance of Cauliflower Curds*

Taste, compactness and appearance of the curds was differed significantly at  $p < 0.01$  among the varieties (Table 3). Significantly better tasty curds score (8.8) was found in Snowball 16 while lower tasty curds score was obtained in Ravella, Casper and Indam 9803 than other varieties. Significantly better compact curds score was found in Titan and Artica but the loosest curds were found in Snowball 16. Significantly better appearance curds score (8.0) was found in Titan and Artica while poor appearance curds score (4.8) was obtained in Indam 9803. The yield along with quality parameters are polygenic in nature, as it was also influenced by the environmental factors and management practices. Such findings on quality parameters were also described by others researcher (Meena *et al.*, 2010; Sharma *et al.*, 2018).

The OP variety, Snowball 16 showed better taste quality, as similar findings was also described by Pun *et al.* (2013).

### *Freshness of Cauliflower Curds*

At different intervals after harvesting of cauliflower, freshness of curds were differed significantly at  $p < 0.01$  among the varieties (Table 4). At three days after harvesting (DAH), significantly higher freshness curds score (7.6) was found in Artica than other varieties. At 6 DAH, significantly more freshness curds score was obtained in Amazing, Artica, Bishop, NS 106 and Snow Mystique. At 9 DAH, significantly higher freshness curds score (6.5) was found in Artica than other varieties but lower freshness score (3.1) was obtained in Casper than other varieties. After harvesting of cauliflower, the poor fresh curds were found in Ravella, Casper and Indam 9803 than other varieties.

## Conclusion

Taste, compactness, appearance and freshness of the curds in late season cauliflower varieties were differed significantly. Maximum moisture and carbohydrate content were found in Freedom while higher crude fat was obtained in Titan and Bishop. Similarly, higher crude protein and crude fiber was found in NS 106. Significantly better tasty curds score was found in Snowball 16 than other varieties. Similarly, highly compact curds were produced by Artica and Titan than other varieties. After harvesting of cauliflower, significantly better appearance and more fresh curds were produced by Artica than other varieties. In conclusion, Snowball 16 produced tastier curds while Artica also produced better appearance and more fresh curds. These two varieties were highly preferred by the consumers based on the taste quality along with appearance and freshness of the curds.

**Table 2.** Nutritional value of late season cauliflower varieties at Rampur, Chitwan during November 2017 to March 2018

Varieties	Moisture (%)	Crude fat (%)	Crude protein (%)	Total ash (%)	Crude fiber (%)	Carbo-hydrate (%)	Calcium (mg/100 g)
Freedom	8.2	2.1	13.7	6.9	6.3	62.8	107.0
Titan	6.6	2.6	20.1	8.7	7.3	54.6	116.0
Ravella	7.3	2.5	16.4	5.2	7.8	60.8	116.0
Amazing	5.8	2.5	18.4	8.7	8.5	56.1	101.0
Artica	6.7	2.4	21.5	8.4	6.9	54.2	77.0
Bishop	7.8	2.6	17.3	7.6	8.6	56.1	96.0
Casper	6.7	2.4	17.0	7.9	6.8	59.3	86.0
Indam 9803	6.7	2.3	17.7	8.3	8.7	56.4	70.0
NS 106	7.8	2.4	22.1	7.2	9.1	51.4	84.0
Snow Mystique	6.3	2.2	20.5	8.4	6.9	55.8	116.0
Snowball 16	5.8	2.5	22.1	9.4	8.7	51.6	107.0
Mean	6.9	2.4	18.8	7.9	7.8	56.3	97.8
Standard deviation	0.81	0.16	2.69	1.13	0.99	3.52	21.61

**Table 3.** Taste, compactness and appearance of late season cauliflower varieties at Rampur, Chitwan during November 2017 to March 2018

Varieties	Taste	Compactness	Appearance
Freedom	7.5 <sup>de</sup>	7.6 <sup>c</sup>	7.1 <sup>c</sup>
Titan	7.3 <sup>e</sup>	8.4 <sup>a</sup>	8.0 <sup>a</sup>
Ravella	5.3 <sup>f</sup>	6.7 <sup>e</sup>	5.3 <sup>d</sup>
Amazing	8.5 <sup>ab</sup>	7.6 <sup>cd</sup>	7.5 <sup>b</sup>
Artica	7.8 <sup>d</sup>	8.3 <sup>a</sup>	8.0 <sup>a</sup>
Bishop	7.8 <sup>cd</sup>	8.0 <sup>b</sup>	7.9 <sup>ab</sup>
Casper	5.0 <sup>f</sup>	6.3 <sup>f</sup>	4.8 <sup>e</sup>
Indam 9803	5.0 <sup>f</sup>	7.3 <sup>d</sup>	5.5 <sup>d</sup>
NS 106	8.2 <sup>bc</sup>	7.6 <sup>c</sup>	7.8 <sup>ab</sup>
Snow Mystique	8.3 <sup>b</sup>	7.6 <sup>cd</sup>	7.9 <sup>ab</sup>
Snowball-16	8.8 <sup>a</sup>	5.0 <sup>g</sup>	5.3 <sup>d</sup>
SEM	0.17	0.13	0.17
LSD <sub>0.05</sub>	0.36 <sup>**</sup>	0.29 <sup>**</sup>	0.38 <sup>**</sup>
CV, %	2.9	2.3	3.1

Means with same letter in column are not significantly different at  $p = 0.05$  by DMRT. \*Significant at 5% ( $p < 0.05$ ), \*\* Significant at 1% ( $p < 0.01$ ) and ns: not significantly different at 5% ( $p > 0.05$ ). SEM = Standard error of mean, LSD = Least significant difference and CV = Coefficient of variance

**Table 4.** Freshness of the curds in late season cauliflower varieties at Rampur, Chitwan during November 2017 to March 2018

Varieties	3 DAH	6 DAH	9 DAH
Freedom	5.7 <sup>de</sup>	5.1 <sup>c</sup>	4.4 <sup>d</sup>
Titan	6.2 <sup>c</sup>	5.7 <sup>b</sup>	5.3 <sup>c</sup>
Ravella	4.2 <sup>f</sup>	3.9 <sup>d</sup>	3.5 <sup>e</sup>
Amazing	7.2 <sup>ab</sup>	6.6 <sup>a</sup>	6.0 <sup>b</sup>
Artica	7.6 <sup>a</sup>	6.9 <sup>a</sup>	6.5 <sup>a</sup>
Bishop	6.9 <sup>b</sup>	6.4 <sup>a</sup>	5.8 <sup>b</sup>
Casper	4.1 <sup>f</sup>	3.9 <sup>d</sup>	3.1 <sup>e</sup>
Indam 9803	5.4 <sup>e</sup>	4.9 <sup>c</sup>	4.2 <sup>d</sup>
NS 106	7.1 <sup>b</sup>	6.5 <sup>a</sup>	6.0 <sup>b</sup>
Snow Mystique	7.1 <sup>ab</sup>	6.5 <sup>a</sup>	6.1 <sup>ab</sup>
Snowball-16	5.9 <sup>cd</sup>	5.2 <sup>c</sup>	4.6 <sup>d</sup>
SEM	0.20	0.21	0.20
LSD <sub>0.05</sub>	0.42 <sup>**</sup>	0.45 <sup>**</sup>	0.43 <sup>**</sup>
CV, %	4.1	4.7	4.9

Means with same letter in column are not significantly different at  $p = 0.05$  by DMRT. \*Significant at 5% ( $p < 0.05$ ), \*\* Significant at 1% ( $p < 0.01$ ) and ns: not significantly different at 5% ( $p > 0.05$ ). SEM = Standard error of mean, LSD = Least significant difference, CV = Coefficient of variance and DAH = Days after harvesting

## Conflict of interest

The authors declare no conflicts of interest regarding publication of this manuscript.

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