

RESEARCH ARTICLES

POST-HARVEST AND QUALITATIVE PERFORMANCE OF HYBRID CULTIVARS OF CAULIFLOWER GROWN AT DANG CONDITION

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ABSTRACT

The study was conducted at Tulsipur, Dang for two years (2021 and 2022 A.D.) to assess postharvest quality performance of hybrid cauliflower. Five hybrid cauliflower cultivars viz. Snow Best, Snow Crown, Super White Top, Rami and Dami were replicated four times in Randomized Complete Block Design. Freshly harvested curds from respective plots were considered in this study. Highest leaf dry matter (13.59%) and TSS (7.060°Brix) was found in Super White Top and Snow Crown, respectively whereas lowest leaf dry matter (11.50%) and TSS (5.12°Brix) in Rami. The color (7.820), compactness score (8.165) in Snow Crown and appearance score (7.846) in Snow Best was highest whereas lowest color (6.290), compactness (6.040) and appearance score (5.39) in Rami. Super White Top showed lowest physiological loss in curd weight with jacket leaves i.e. 13.99%, 20.21% and 27.66% at 5, 7 and 9 days after harvesting (DAH) respectively whereas Rami showed the highest loss i.e. 19.02%, 24.36%, and 30.73% at 5, 7 and 9 DAH, respectively. Lowest physiological losses in curd weight without jacket leaves recorded were 13.29%, 18.15%, and 23.70 % at 3, 5 and 7 (DAH,) respectively in Snow Crown and 29.78% at 9 DAH in Super White Top whereas, the highest loss i.e. 15.46%, 24.65% and 29.56% at 3, 5 and 7 DAH respectively in Dami and 37.80% at 9DAH Rami. Lowest spoilage loss of curd with and without jacket leaves was recorded in Snow Crown 29.23% and 35.79% respectively whereas the highest in Dami cultivar i.e. 35.31% and 43.60% respectively.

Keywords: Cauliflower, postharvest, hybrid, cultivars, Nepal

INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis* L.), queen of winter vegetables, is an important vegetable widely grown in Terai, and Mid Hills (Pradhan et al., 2023) of Nepal and is known to be originated in Mediterranean region (Bose and Som, 1993). The immature flower buds are usually used for consumption which contains carbohydrates, protein, fat, potassium, phosphorous, Sulphur, iron, copper, carotenoids, β -carotene, vitamin-A, B1 and C. In context of Nepal, a total of 574,798 mt of cauliflower is produced in an area of 35,765 ha land with an average productivity of 14.95 mt/ha. In addition, Dang district covers an area of 385 ha of land with total production of 5,899 mt productivity of 15.32 (MOAD, 2020/21). Nepal government has realized the importance and the scope of vegetable farming along with the emerging cauliflower as a good source vegetable enterprise providing income within short period of time.

Several hybrid cultivars from different country have been imported in Nepal in relation to productivity every year because of open boarder situation. Several production trials have been experimented at farmer's field before they reach to the farmers. In spite of this, the productivity of cauliflower has not still reached the desired level. The yield variation among different cultivars might be due to the environmental variations at different regions (Ndiaga, 2000). In addition, genetic and heritable variability also govern the vegetative characteristics and curd yield traits. There is a must need for genetic improvement and research study to develop the cultivars with acceptable and better traits.

Majority of the farmers in Nepal are cultivating cauliflower in winter season and it is a must need to identify the best hybrid cultivars at Nepalese condition. In the same line, this study aims to find out the best hybrid cauliflower cultivars suited for Dang condition of Lumbini province.

MATERIALS AND METHODS

Location and design of the study

The research was carried out at Horticulture department of Campus of Live Sciences situated at Tulsipur, Dang during 2021 and 2022 A.D. Five hybrid cauliflower cultivars viz. Snow Crown, Super White Top, Snow Best, Rami and Dami were replicated four times in Randomized Complete Block Design. Freshly harvested curds from the respective plots were considered in postharvest and sensory study and carried out under laboratory condition. The laboratory research was laid out in Completely Randomized Design (CRD) with four replications.

Determination of dry matter content of leaf and curd

According to Panthi et al. (2020) the harvested curds and leaves from each plot were cut individually and 100 gm sample of leaf and curds were oven dried for 48 hours at 650C in hot air oven (SSU-106 Oven Universal-Memert type, Sanjeev Scientific Udyog, India). The percent dry matter content was calculated by using the formula as;

$$DM = \frac{(Ws-Ds)}{Ws} \times 100$$

Where, DM = Dry matter (%), Ws = curd sample (gm), Ds= Oven dry sample (g)

Determination of vitamin c content of curd

Firstly, 5 ml of working standard solution was prepared by dissolving fresh cauliflower curd sample. Then, 10 ml of 4 % oxalic acid (Fizmerk, Fizmerk India Chemicals, India) added to the standard solution, and titrated against the dye (V1ml) until the appearance of pink color (end-point), thus the amount of dye consumed is equivalent to the amount of ascorbic acid. To make known volume (100 ml), 0.5–5 g sample was extracted on 4 % oxalic acid and centrifuged. Then, 5 ml of supernatant was pipette out (ZI 2066D, Zeal International, India) and 10 ml of 4 % oxalic acid added. It was titrated against the dye (V2 ml) until pink color develops (Basnet et al., 2017). Finally, amount of ascorbic acid (vitamin C) calculated with the following formula:

$$\text{Amount of ascorbic acid (mg/100 gm of curd)} = \frac{1000.5 \text{ mg} \times V2 \text{ ml} \times 100 \text{ ml}}{V1 \text{ ml} \times 5 \text{ ml} \times \text{wt. of sample}}$$

V1= Titrated volume of standard solution against dye

V2= Titrated volume of sample solution against dye

Determination of Total Soluble Solid (TSS)

The cauliflower curds were ground and the curd juice was kept on prism of Refractometer (RHB 32 ATC, ERMA Refractometer, Japan) to measure TSS in Degree Brix.

Scale	Colors	Compactness	Appearance	Acceptability
1-3	Poor	Loose	Poor	Acceptable
3-5	Good	Slightly loose	Attractive	Preferred
5-7	Better	Compact	More attractive	More preferred
7-9	Best	Very Compact	Highly attractive	Highly preferred

Organoleptic test

An organoleptic test was conducted by involving 50 personnel to evaluate the curd characteristics based on the following parameters and numbering system (Giri et al., 2020).

Physiological loss in weight: The physiological loss in weight (PLW) of randomly selected five sample curds with and without their jacket leaves were examined by keeping them in normal room condition for nine days (Basnet et al., 2017). PLW was calculated by using following formula:

$$PLW = \frac{\text{Initial weight} - \text{Fresh weight of the sample}}{\text{Final weight of the sample}} \times 100$$

Spoilage loss: The spoilage loss of randomly selected five sample curds with and without their jacket leaves were examined by keeping them in ordinary room condition for nine days (Basnet et al., 2017). It was calculated by using following formula:

$$\text{Spoilage (\%)} = \frac{\text{Weight of the spoiled curds}}{\text{Original weight of the curd}} \times 100$$

Statistical analysis: GenStat for Teaching and Learning (18th Edition) was used for the analysis of variance and other data analysis. Means were compared using Duncan's Multiple Range Test (DMRT) at 0.05 and 0.01 level of significance.

RESULTS AND DISCUSSION

Biochemical parameters of cauliflower

The curd dry matter and vitamin c content on different hybrid cultivars was found to be insignificant whereas, the highest leaf dry matter (13.59%) was found to be significant in Super White Top whereas lowest (11.50%) was found in Rami cultivars. In addition, Snow Crown cultivar showed the significant results with highest TSS (7.060⁰Brix) whereas lowest TSS (5.12⁰Brix) was found in Rami cultivar (Table 1). The curd and leaf dry matter percent, vitamin c content and TSS were found to be significant on various hybrid cultivars of cauliflower. The variation of these biochemical parameters might be due to both genetic and environmental influences such as nutrient source, climatic condition, soil fertility status, as similar finding was mentioned by Abbey et al. (2002).

Organoleptic test and sensory evaluation

The color score (7.820) and compactness score (8.165) was found to be significantly highest in Snow Crown whereas lowest color score (6.290) and compactness score (6.040) was found in Rami cultivars. Similarly, significantly highest appearance score of 7.846 was found in Snow Best and lowest appearance score of 5.939 was found in Rami cultivars. The acceptance score was found to be non-significant (Table 2).

Table 1 Mean leaf dry matter, curd dry matter, TSS and vitamin c of different hybrid cauliflower cultivars in Tulsipur, Dang (2021 to 2022 AD)

Treatments	Leaf dry matter (%)	Curd dry matter (%)	TSS (^o Brix)	Vitamin C (mg/100 g)
Snow Best	11.59 ^a	14.27 ^a	5.385 ^a	36.40 ^a
Snow Crown	12.50 ^{ab}	14.71 ^a	7.060 ^b	36.82 ^a
Super White Top	13.59 ^b	15.08 ^a	6.988 ^b	36.74 ^a
Rami	11.50 ^a	13.73 ^a	5.12 ^a	36.02 ^a
Damy	11.63 ^a	14.65 ^a	5.435 ^b	36.64 ^a
Grand mean	12.2	14.5	6.0	36.5
SEM	0.38	0.40	0.32	0.21
F-test	**	NS	**	NS
LSD _{0.05}	1.11	1.16	0.93	0.62
CV %	8.9	7.8	15.1	1.6

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

The scoring in terms of color, compactness and appearance showed the significant results in hybrid cultivars of cauliflower. The significant variation was also found in various cauliflower cultivars, might be due to genetic characteristics of the varieties (Giri et al., 2020), The similar results were achieved by Meena et al. (2010); Sharma et al., (2018) & Pun et al. ,(2003).

Physiological loss in weight of cauliflower with jacket leaves

Physiological loss in weight of curd with jacket leaves of cauliflower during storage period showed significant results only after 5 days after harvesting (DAH) whereas it was non-significant at 3 DAH. Super White Top cultivars showed significantly the lowest physiological loss in weight i.e. 13.99%, 20.21% and 27.66% at 5, 7 and 9 DAH, respectively. Moreover, Rami cultivar showed significantly the highest physiological loss in weight i.e. 19.02%, 24.36%, and 30.73% at 5, 7 and 9 DAH respectively (Table 3).

Table 2 Mean color, compactness, appearance, and acceptance of different hybrid cauliflower cultivars in Tulsipur, Dang (2021 to 2022 AD)

Treatments	Color	Compactness	Appearance	Acceptance
Snow Best	7.079 ^{ab}	6.352 ^a	7.846 ^b	7.257 ^a
Snow Crown	7.820 ^b	8.165 ^b	7.345 ^{ab}	8.195 ^a
Super White Top	7.696 ^{ab}	7.477 ^{ab}	6.938 ^{ab}	7.850 ^a
Rami	6.290 ^a	6.040 ^a	5.939 ^a	6.915 ^a
Damy	7.105 ^{ab}	7.287 ^a	7.374 ^{ab}	7.447 ^a
Grand mean	7.2	7.1	7.1	7.5
SEM	0.34	0.37	0.42	0.32
F-test	*	**	*	NS
LSD _{0.05}	1.00	1.06	1.23	0.94
CV %	13.5	14.7	16.9	12.1

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, CV = Coefficient of variance

Physiological loss in weight of cauliflower without jacket leaves

Physiological loss in weight of curd without jacket leaves of cauliflower during storage period showed significant results. The lowest physiological losses in weight recorded in Snow Crown were 13.29%, 18.15%, and 23.70 % at 3, 5 and 7 days after harvesting (DAH), respectively whereas, Damy cultivars showed significantly the highest physiological loss in weight of curd without jacket leaves i.e. 15.46%, 24.65% and 29.56% at 3, 5 and 7 DAH respectively. In addition, on 9DAH, the lowest physiological loss in weight (29.78%) was found in Super White Top cultivars and highest (37.80%) in Rami cultivars (Table 4).

Spoilage loss in cauliflower with and without jacket leaves

Spoilage loss in relation to jacket leaves and without jacket leaves gave the significant results. The lowest spoilage loss along with and without jacket leaves was recorded to be 29.23% and 35.79% respectively in Snow Crown cultivars whereas the highest spoilage loss was found in Damy cultivar with and without jacket leaves i.e. 35.31% and 43.60% respectively (Table 5).

Table 3 Mean physiological loss in weight with jacket leaves of different hybrid cauliflower cultivars in Tulsipur, Dang (2021 to 2022 AD)

Treatments	Physiological loss in weight of cauliflower with jacket leaves (%)			
	3 DAH	5 DAH	7 DAH	9 DAH
Snow Best	10.14 ^a	17.83 ^c	23.08 ^c	30.06 ^{bc}
Snow Crown	10.85 ^a	15.83 ^b	20.89 ^b	28.00 ^a
Super White Top	9.60 ^a	13.99 ^a	20.21 ^a	27.66 ^a
Rami	10.45 ^a	19.02 ^d	24.36 ^d	30.73 ^c
Damy	10.49 ^a	18.61 ^d	24.11 ^d	29.71 ^b
Grand mean	10.3	17.1	22.5	29.2
SEM	0.50	0.15	0.11	0.18
F-test	NS	**	**	**
LSD _{0.05}	1.46	0.44	0.31	0.51
CV %	3.8	2.5	1.3	1.7

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

Table 4. Mean physiological loss in weight with jacket leaves of different hybrid cauliflower cultivars in Tulsipur, Dang (2021 to 2022 AD)

Treatments	Physiological loss in weight of cauliflower without jacket leaves (%)			
	3 DAH	5 DAH	7 DAH	9 DAH
Snow Best	14.07 ^b	21.51 ^b	27.74 ^c	35.01 ^c
Snow Crown	13.29 ^a	18.15 ^a	23.70 ^a	30.64 ^b
Super White Top	13.80 ^b	18.68 ^a	24.78 ^b	29.78 ^a
Rami	14.59 ^c	22.81 ^c	29.00 ^d	37.80 ^d
Damy	15.46 ^d	24.65 ^d	29.56 ^d	34.90 ^c
Grand mean	14.2	21.2	27	33.6
SEM	0.12	0.17	0.18	0.17
F-test	**	**	**	**
LSD _{0.05}	0.50	0.68	0.53	0.49
CV %	2.4	2.2	1.9	1.4

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

Table 5 Mean spoilage loss with and without jacket leaves of different hybrid cauliflower cultivars in Tulsipur, Dang (2021 to 2022 AD)

Treatments	Spoilage loss in cauliflower	
	With jacket leaves	Without jacket leaves
Snow Best	33.40 ^c	41.76 ^c
Snow Crown	29.23 ^a	35.79 ^a
Super White Top	31.00 ^b	37.91 ^b
Rami	34.49 ^d	41.07 ^c
Damy	35.31 ^e	43.60 ^d
Grand mean	32.7	40
SEM	0.10	0.22
F-test	**	**
LSD _{0.05}	0.28	0.65
CV %	0.8	1.6

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

The physiological loss and spoilage loss in weight of cauliflower was found to be significant both with and without jacket leaves. This variation on physiological loss in weight and spoilage loss in cauliflower curd among different cauliflower varieties was achieved by Yadav et al. (2013), Kumar et al. (2011); Kido & Singh (2018).

The significant differences on postharvest parameter and sensory quality parameters of different cauliflower genotypes were estimated with each other even on the same growing condition, which might be due to different characteristics of genotypes governed by different genes; and they were greatly influenced by environmental factors and management practices (Khanal et. al., 2022). Similar results were reported by Poudel et. al. (2017); Khatiwada & Chaudhary (2004); Budhathoki et al. (2004).

CONCLUSION

It was found that the biochemical parameters such as leaf dry matter and TSS; organoleptic taste and sensory evaluation, physiological loss in weight and

spoilage loss both with and without jacket leaves were significantly different in different hybrid cauliflower cultivars. The highest leaf dry matter (13.59%) and highest TSS (7.060°Brix) was found to be significant in Super White Top and Snow Crown respectively whereas lowest leaf dry matter (11.50%) and TSS (5.12°Brix) was found in Rami cultivars. The color score (7.820) and compactness score (8.165) was found to be significantly highest in Snow Crown whereas lowest color score (6.290) and compactness score (6.040) was found in Rami cultivars. Similarly, significantly highest appearance score of 7.846 was found in Snow Best and lowest appearance score of 5.939 was found in Rami cultivars. Super White Top cultivars showed significantly the lowest physiological loss in weight of curd with jacket leaves i.e. 13.99%, 20.21% and 27.66% at 5, 7 and 9 DAH respectively. Moreover, Rami cultivar showed significantly the highest physiological loss in weight of curd with jacket leaves i.e. 19.02%, 24.36%, and 30.73% at 5, 7 and 9 DAH respectively. The lowest physiological losses in weight of curd without jacket leaves recorded in Snow Crown were 13.29%, 18.15%, and 23.70 % at 3, 5 and 7 days after harvesting (DAH) respectively whereas, Damy cultivars showed significantly the highest physiological loss in weight of curd without jacket leaves i.e. 15.46%, 24.65% and 29.56% at 3, 5 and 7 DAH respectively. In addition, on 9 DAH, the lowest physiological loss in weight of curd without jacket leaves (29.78%) was found in Super White Top cultivars and highest (37.80%) in Rami cultivars. The lowest spoilage loss of curd along with and without jacket leaves was recorded to be 29.23% and 35.79% respectively in Snow Crown cultivars whereas the highest spoilage loss was found in Damy cultivar with and without jacket leaves i.e. 35.31% and 43.60% respectively. Considering the economically important postharvest attributes Snow Crown and Super White Top were found to be the suitable hybrid mid-season cauliflower cultivars to be grown in Dang condition.

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