

Original Research Article

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**Variability for Ascorbic Acid, Beta Carotene and Minerals
Content (Phosphorous, Potassium and Calcium) in Knolkhol
(*Brassica oleracea* var. *gongylodes* L.) Genotypes**

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A B S T R A C T

An experiment was conducted to study the variability for ascorbic acid, beta carotene and minerals content (phosphorous, potassium and calcium) in knolkhol (*Brassica oleracea* var. *gongylodes* L.) genotypes under sub-tropical condition of Jammu, at Vegetable Research Farm, SKUAST-J, Main campus, during the year 2016-17. High heritability (>70%) was estimated for all the quality traits and moderate for marketable knob weight/plant. High genetic advance as percentage of mean coupled with moderate to high heritability were obtained for beta carotene contents of knob, calcium contents of knob and marketable knob weight/plant indicating thereby that the selection based on phenotypic performance could be effectively utilized for isolation of superior genotypes. Moderate to high heritability and moderate genetic advance was observed for calcium contents of leaves, phosphorous contents of knob, ascorbic acid contents of knob and leaves and beta carotene contents of leaves indicates the involvement of both additive and non-additive genes.

Keywords

Heritability, Quality and variability

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Introduction

Knolkhol (*Brassica oleracea* var. *gongylodes* L.) is an important cole crop widely grown in Jammu and Kashmir, West Bengal and to a limited extent as a rare exotic vegetable in some parts of Maharashtra, Assam, Uttar Pradesh and Punjab (Thamburaj and Singh, 2010). The vegetable *Brassic*as are consumed for their nutritional values, namely minerals, carotenoids and vitamins content (Farnham *et al.*, 2000). The carotenoids, vitamin C and E are now firmly established as protective dietary antioxidants (Sies and Stahl, 1995).

Significant variability was reported for calcium and magnesium content among broccoli cultivars (Farnham *et al.*, 2000), but with respect to the mineral content in knolkhol only meager information is available on the genetic variability of minerals in cole crops and none of the studies describe the genetic diversity in knolkhol. Mineral concentration in head of cabbage varied highly significantly among the cultivar and germplasm indicating the presence of sufficient variability (Singh *et al.*, 2010). To the best of our knowledge, only meagre information is available on the variability, heritability, inheritance in

knolkhol. It is thus important to ascertain the ascorbic acid content, beta carotene content and mineral nutrition characteristics of knolkhol for identifying and developing superior cultivars rich with quality parameters.

Materials and Methods

The present investigation was carried out under subtropical conditions of Jammu at Vegetable Experimental Farm, Division of Vegetable Science and Floriculture, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology, Main Campus, Chatha, Jammu (J&K) during during (Sept–Oct) of the year 2016-17. The experimental field of Division of Vegetable Science and Floriculture, SKUAST, Jammu is situated at 32° 40'N latitude and 74° 58' E longitude and has an elevation of 332 m above mean sea level. The experimental material comprised of 30 diverse genotypes of knolkhol collected from diverse agro-climatic regions of J&K along with two genotypes from IARI, Katrain, one from CSKHPKV, Palampur and three hybrids. The details of the genotypes along with their source are given below in Table 1. The experimental was laid out in Randomized Block Design with three replications during (Sept–Oct) of the year 2016-17. The sowing of all genotypes was done in nursery bed and 25 days old seedlings were transplanted at the spacing of 30 cm between rows and 30 cm between plants within the rows. The package and practices to raise successful crop of knolkhol was followed. Five plants were randomly selected from each replication per genotype for recording the various growth and yield attributing traits. The mean value was used as the replicated data and was subjected to statistical analysis using INDOSTAT software package. The data of quality traits were statistically analyzed as per methods out lined by Panse and Sukhatme (1967) for estimating the analysis of variance (ANOVA),

heritability in a broad sense (Burton and De Vane 1953), genetic advance (Johnson *et al.*, 1955), Leaf and knob sample of each genotype in replication was taken at fresh marketable stage and used to estimate ascorbic acid content of knob and leaves as per method suggested by (Sadasivam and Theymoli, 1987) and beta carotenet content of knob and leaves by as per method of (Sadasivam and Manickam, 1992). The fresh marketable knob and leaves was chopped, air dried and kept in hot air oven at 60-65 °C for drying.

These dried samples were powdered by using stainless steel blade mixer and finally stored in airtight container for the analysis of minerals. 0.5 g of dried tissues was digested with a mixture of perchloric acid and nitric acid (1:4). Dried tissues (0.5 g) and 10 ml of acid mixture were put in 100 ml conical flask, allowed over-night for pre-digestion, and then heated at 100 °C for an hour and 250 °C until the solution turned colourless and volume was reduced to 2-3 ml. The digested plant material was made up to 50ml with double distilled water and filtered. The filtrate was used for determination of calcium, potassium and phosphorous concentration as per the methods suggested by Prasad *et al.*, (2006).

Results and Discussion

The mean squares (Table 2) revealed highly significant differences among the genotypes for the content of ascorbic acid, beta carotene and the minerals such as P, K and Ca as well as head weight indicating the presence of sufficient natural variation, which could be exploited through various breeding approaches. Singh *et al.*, (2009) also reported sufficient amount of variability for minerals content in cultivars and hybrids of cabbage. The extent of variability for all the quality traits (Table 3) was estimated in terms of phenotypic and genotypic coefficient of variation (PCV and GCV).

Table.1 List of genotypes along with the source

S. No.	Code	Genotype	Source
Released varieties and advance breeding lines of SKUAST- J and SKUAST- K			
1.	G1	G40	SKUAST-J
2.	G2	SJKK-02	SKUAST-J
3	G3	SJKK-03	SKUAST-J
4	G4	SJKK-04	SKUAST-J
5	G5	SJKK-05	SKUAST-J
6	G6	SKKK-01	SKUAST-K
7	G7	SKKK-02	SKUAST-K
8	G8	SKKK-03	SKUAST-K
Public Sector Varieties			
9	G9	Early White Vienna	Directorate of Agriculture, Jammu
10	G10	King of Market-I	Directorate of Agriculture, Jammu
11	G11	Early SWV	NFCC, Jammu
12	G12	Kargil Local	Kargil
13	G13	Purple Vienna-I	JK krishi vikas Cooperative Ltd, Pulwama
14	G14	Knolkhol White	JK Krishi Vikas Cooperative Ltd, Pulwama
15	G15	King of Market-II	Sultan seeds, Munwarabad
16	G16	Purple Vienna-II	Sultan seeds, Munwarabad
17	G17	Pusa Virat	IARI, Katrain (HP)
18	G18	White Vienna	IARI, Katrain (HP)
19	G19	Palam Tender Knob	CSKHPKV, Palampur
Local Germplasm of J & K			
20	G20	Farashi Lajwari Local	Sopore
21	G21	Farashi Safed Local	Sopore
22	G22	Sopore Local	Sopore
23	G23	Baramullah Local	Baramullah
24	G24	Ganderbal Local	Ganderbal
25	G25	Leh Local	Leh
26	G26	Rajouri Local	Rajouri
27	G27	Nowpora Local	Nawpora
Private sector hybrids			
28	G28	Mamta	Crop Life Hybrid Seeds, Punjab
29	G29	Green Gold	Indus Seeds, Bangalore
30	G30	C-2002	Century Seeds, New Dehli

Table.2 Analysis of variance (mean sum of squares) for quality traits in knolkhol (*Brassica oleracea* var. *gongylodes* L.)

Sl. No.	Source of variation/ Characters	Genotypes	Error	CD (5%)
Quality traits				
	Ascorbic acid content of knob (mg/100g)	23.17**	1.22	1.26
	Ascorbic acid content of leaves (mg/100g)	56.26**	3.42	2.10
	Beta carotene content of knob(mg/100g)	0.62**	0.02	0.15
	Beta carotene content of leaves (mg/100g)	0.97**	0.32	0.64
	Calcium content of knob (mg/100g)	136.74**	14.83	5.82
	Calcium content of leaves (mg/100g)	187.81**	10.28	4.85
	Potassium content of knob (mg/100g)	136.74**	187.81	3.09
	Potassium content of leaves (mg/100g)	67.50**	3.73	2.92
	Phosphorous content of knob (mg/100g)	13.07**	1.16	1.63
	Phosphorous content of leaves (mg/100g)	10.74**	0.28	0.79

Table.3 Estimates of variability parameters for various traits in knolkhol (*Brassica oleracea* var. *gongylodes* L.)

Characters	Mean± SE	Range	Coefficient of variation (%)		Heritability % (Broad sense)	Genetic Advance	Genetic Advance as % age of mean
			PCV	GCV			
Beta carotene content of knob	2.15 ± 0.08	1.55-3.47	21.68	20.81	92.13	1.13	52.73
Beta carotene content of leaves	7.34 ± 0.33	5.95-8.37	9.97	6.36	80.66	0.79	10.70
Ascorbic acid content of knob	53.87 ± 0.64	49.84-59.00	5.42	5.02	85.70	6.61	12.27
Ascorbic acid content of leaves	92.69 ± 1.07	81.33-100.37	4.95	4.53	83.73	10.14	10.94
Calcium content of knob	59.68 ± 2.22	50.00-69.33	12.48	10.68	73.26	11.53	20.33
Calcium content of leaves	101.77 ± 1.85	88.33-117.43	8.19	7.56	85.20	14.63	14.37
Potassium content of knob	353.82 ± 1.18	346.84-360.07	1.11	0.94	72.76	7.52	2.13
Potassium content of leaves	267.23 ± 1.11	253.37-274.00	1.87	1.73	85.08	11.23	4.20
Phosphorous content of knob	33.55 ± 0.62	29.71-39.08	6.75	5.94	77.45	4.63	13.80
Phosphorous content of leaves	50.77 ± 0.30	47.26-56.80	3.82	3.68	92.68	4.75	9.35
Marketable knob weight per plant	360.61 ± 24.14	280.65-447.29	15.95	10.96	47.19	72.66	20.13

The magnitude of PCV was slightly higher than the corresponding GCV for ascorbic acid and beta carotene content and minerals contents indicating lesser influence of environment on accumulation of minerals in knob. The result is in accordance with the findings of Hakala *et al.*, (2003) and Singh *et al.*, (2010). Heritable portion of variation can be estimate by computing the heritability and genetic advance as percentage of mean. High heritability (>70%) was estimated for all the quality traits (Table 3). A high heritability for the traits indicates that a large portion of phenotypic variance is contributed through genotypic variance and therefore a reliable selection can be made for these traits, but moderate heritability for marketable knob weight (47.19%) indicates a considerable influence of environment. Similar findings have been reported by Santhosha *et al.*, (2015) for ascorbic acid content and marketable knob weight/plant in cauliflower, Singh and Singh (2013) for calcium and potassium content in cabbage, Singh *et al.*, (2013) for phosphorous and calcium contents in cabbage.

High heritability alone is not enough to make sufficient improvement through selection generally in advance generations, unless accompanied by substantial amount of genetic advance (Bhargava *et al.*, 2003. Genetic advance as percentage of mean varied from 2.13 to 52.73 %. It was estimated high for beta carotene contents of knob (52.73%), calcium contents of knob (20.33) and marketable knob weight (20.13), while it was moderate for calcium contents of leaves (14.37 %), phosphorous contents of knob (13.80 %), ascorbic acid contents of knob and leaves (12.27 %) and 10.94 %), beta carotene contents of leaves (10.70 %) and low for potassium contents of knob and leaves (2.13 % and 4.20 %)), phosphorous contents of leaves (9.35 %). Heritability estimates along with genetic advance as percentage of mean, together, are more useful in predicting the gain under selection than either of them alone (Singh and Chaudhary, 1977). In the present study, high genetic advance as percentage of mean coupled

with moderate to high heritability were obtained for beta carotene contents of knob, calcium contents of knob and marketable knob weight/plant indicating thereby that the selection based on phenotypic performance could be effectively utilized for isolation of superior genotypes for these traits as these are controlled by additive gene action (Panse, 1957). Moderate to high heritability and moderate genetic advance was observed for calcium contents of leaves, phosphorous contents of knob, ascorbic acid contents of knob and leaves and beta carotene contents of leaves indicates the involvement of both additive and non-additive genes. Similar findings have been observed by Singh *et al.*, (2013) in cabbage for head weight/plant and potassium content in cabbage; Singh and Singh (2013) in cabbage for calcium and potassium content. Ghebramlak *et al.*, (2004) for calcium and potassium content in cabbage who reported moderate to high heritability and moderate genetic advance for these traits.

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