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To find out the nutritional characteristics of some promising varieties/genotypes of chickpea

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Abstract
Twenty varieties/genotype *viz*. Vijay, BG-256, JG-16, CSG-8961, BG-372, K-3256, KWR-108, KPG-59, Radhey, Avarodhi KGD-1288, KGD-1295, KGD-1296, KGD-1302, KGD-1315, KGD-1316, KGD-2012, Pusa-209, Pusa-391 and RBG-1 were taken from oil seed research farm Chandra Shekhar Azad University of Agriculture and Technology, The quality parameter like Protein content, Total carbohydrate content, Fat content, Ash content, Calorific value and Moisture content were studies under after harvest of crop. Grain sample from different varieties/genotypes were brought to laboratory. The range of variability in chickpea varieties/genotypes was from Protein content (22.44-24.15%), Total carbohydrate content (67.91-69.92%), Fat content (4.41-5.16%), Ash content (2.58-3.07%), Calorific value (409.87-414.37 Kcal/g) and Moisture content (5.76-7.61%) Among the Chickpea variety Avarodhi appeared to be the best having excelled in two Nutritional characters such as protein content and calorific value out of the six quality parameter was studied.

Keywords: Protein content, total carbohydrate content, fat content, ash content, calorific value and moisture content

Introduction
Chickpea commonly known as gram or Bengal gram (*Cicer arietinum* L.), a member of family Leguminaceae and subfamily Papilinoceae, is an important self-pollinated leguminous crop, diploid annual (2n = 16 chromosomes). It is the most important crop of India grown during rabi season. Among the pulses, chickpea is grown since 7000 BC in different areas of the world but its cultivation is mainly concentrated in semi-arid environments. It is grown mainly in India, Pakistan, Iran, Burma, Turkey, Spain, Portugal, Morocco, Ethiopia, Tanzania, Chile, Mexico, and USA. India ranks first in the world in respect of production as well as acreage of chickpea crop followed by Pakistan (Uttamrao *et al*., 2018) [13].
Pulses including beans and chickpea are the most important crops in the world because of their nutritional quality. They are rich sources of carbohydrates, protein, vitamins and minerals (Costa *et al.*, 2006 and Wang *et al*., 2010) [5] Chickpea is a popular crop in the arid and semi-arid areas of North-Western China (Zhang *et al.* 2007) [15] Due to their good balance of amino acid, high protein bioavailability and relatively low levels of anti-nutritional factors, chickpea grains have been considered a suitable source of dietary proteins.
Bengal gram (*Cicer arietinum*) is a nutritive pulse extensively used as a protein adjunct to starchy diets. Analysis of gram gave the values: whole gram protein, 17.1%; fat (ether-extract), 5.3%; mineral matter, 2.7%; fibre, 3.9%; carbohydrates, 61.2%; calcium, 0.19%; phosphorus, 0.24%; carotene (vitamin A), 316 international units per 100g; vitamin B_1, 100 I.U. per 100g; roasted gram without husk moisture, 11.2%; protein, 22.5%; fat (ether-extract), 5.2%; mineral matter, 2.2%; fiber, nil; carbohydrates, 58.9%; calcium, 0.07% and phosphorus, 0.3%. whole gram contains sucrose, fructose, glucose, polysaccharides, betaine, choline, adenine, inositol, and citric and oxalic acids. Tender shoots of the plant are used as vegetable. They have the following composition: moisture, 60,6%; protein, 8.2% fat (ether-extract) 0.5%; carbohydrates, 27.2 %; ash, 3.5% calcium, 0.31%; phosphorus, 0.21%; carotene 6700 I.U. per 100g.

Materials And Methods
1. Protein content*:* Protein estimation by micro-Kjeldahl method was developed in 1883 by a brewer called Johann Kjeldahl (A.O.A.C., 1970) [1]
For determination of crude protein in sample, first the nitrogen was determined and then it was multiplied with a suitable correction factor to get the value of crude protein.

In most proteins, nitrogen constitutes 16 % of the total makeup and hence the nitrogen content of the sample was multiplied by 6.25 to get the value of the crude protein.

2. Total carbohydrate content: Total carbohydrate was determined by the difference method formula. The following formula used for determining the total carbohydrate per cent is as follow:
Total carbohydrate % = 100 – (Protein% + Ash% + Ether extract %)

3. Fat content: Fat extractable lipid content in chickpea seed was determined by Soxhlet Extraction procedure using petroleum ether of boiling point 40-60 ^{0}C for six hours in a flash (A.O.A.C., 1970) [1]. Fat content was calculated using the following formula:

$$\text{Ether extract percentage in seed sample} = \frac{weight\ of\ extract\ (g)}{weight\ of\ sample\ (g)} \times 100$$

4. Ash content: Ash content was determined by the method as described by Hart and Fisher, (1971) [7]. Materials required for this estimation were silica crucible muffle furnace 600ºC and desiccators with magnesium per chlorate desiccant. In this method the constant weight of silica crucible in muffle Furness at 600 ºC for one hours, transferring from furnace to desiccators weighing and repiting the above mentioned process till a constant weight of silica crucible were recorded, 0.2 g dried sample which was dried was transferred into ash less filter paper. The ignition of sample was carried out on non luminous flame in a pre weighed, teared silica crucible. The crucible was finally placed into muffle furnace which was maintained at 525-550 ºC (± 2 ºC) for about 5-6 hours to destroy the organic matter of the sample. After expiry of period, the crucible was transferred into desiccators for cooling to avoid absorption of moisture, by the ash. The cold ash along with silica crucible was weighed and the result was calculated and reported on moisture free basis into per cent.

Calculation
Weight of ash = Weight of Silica Crucible with Ash – Weight of Empty Silica Crucible.

5. Calorific Value: The calorific value of chickpea seed was calculated using Atwater and Bryant factor as quoted by Sherman (1952) [12]. The factors of 4, 9 and 4 Kcal/g of protein, fats and carbohydrate respectively were used (Sherman, 1952) [12].

6. Moisture content: Moisture content of mustard sample was determined by a thermostat controlled oven. Empty aluminum moisture dish was weighted (W1) and sample was taken in a moisture dish and weighted (W2). The sample was spread evenly and placed without lid in oven and dried samples for 4 hrs. at 80°C temperature. The dishes were transferred to desiccators to cool. Aluminum dish was weighed after cooling (W3).
The percentage of the moisture was then calculated by the following formula proposed in (AOAC, 1973) [2].

$$\%\ \text{Moisture} = \frac{W2 - W3}{W2 - W1} \times 100$$

Results and Discussion
Protein Content
The protein content showed significant variations in different varieties/genotypes during both the years as well as pooled data. Protein content in chickpea in different varieties/ genotypes ranged from 22.44 to 24.15 per cent with a mean value of 23.54 per cent of chickpea. The highest protein content (24.15%) was recorded in chickpea variety Avarodhi followed by KWR-108 and CSG-8961 gave protein content of 24.08 and 23.82 per cent. The minimum protein content of 22.44% in was recorded in chickpea genotype KGD-1296. Jadhav *et al*. (2015) [8] reported that the protein content of chickpea varied from 13.25 to 26.77%. Similarly Sharma *et al.* (2013) [11] found that the protein content ranged from 18 to 31%.

Carbohydrate Content
It is clearly indicated that the chickpea varieties/genotypes varied significantly in carbohydrate content ranged from 67.91 to 69.92 per cent with mean value of 69.06 per cent. The genotypes KGD-1315 showed highest carbohydrate content of 69.92 per cent, followed by KGD-1296 and RBG-1 recorded carbohydrate content of 69.85 and 69.69 per cent, respectively. Chickpea variety Avarodhi showed minimum value of carbohydrate content of 67.90 per cent of chickpea. Similarly carbohydrate content in chickpea seeds ranging from 65.50-68.65 per cent as reported by Karadavut and Genc (2012) [10]. Garg and Sabharwal (2014) [6] recorded the carbohydrate content in chickpea and pigeon pea which was found to be maximum of 62.70 g/100g.

Fat Content
The fat content showed significant variation in fat content of chickpea ranged from 4.41 to 5.16 per cent with a mean value to 4.82 percent. Chickpea genotype JG-16 showed maximum fat content of 5.16 per cent followed by Radhey and Avarodhi recorded fat per cent of 5.13 and 5.13 per cent, respectively. Chickpea genotype KGD-1316 produced minimum fat content of 4.41 percent. Carla *et al.* (2013) [4] reported that the fat content in chickpea of different varieties from 5.25 to 6.20 per cent. Similarly Bulbula and Urga (2018) [3] recorded that the fat content ranged from 2.3 to 2.7 per cent.

Ash Content
It is observed that the chickpea varieties/genotypes varied significantly in ash content of chickpea in different varieties /genotypes of chickpea ranged from 2.58 to 3.07 per cent with mean a value of 2.87%. Chickpea variety Radhey showed highest ash content of 3.07 per cent followed by K-3256 and Pusa-209 recorded ash content of 3.06 and 3.05 per cent, respectively. Genotypes KWR--108 showed minimum value of ash content of 2.58 per cent of chickpea. Kabuo *et al.* (2015) [9] reported that the variability in ash content in chickpea ranged from 3.05 to 10.85 per cent. Carla *et al.* (2013) [4] reported variability in ash content in chickpea varieties ranged from 3.55 to 4.46 per cent.

Calorific Value
It is evident from the data that significant differences were observed in calorific value in different chickpea varieties/ genotypes and ranged from 409.87 to 414.37 K calories with a mean value of 412.64 K calories of chickpea. Variety Avarodhi recorded the highest calorific value 414.37 K calories, followed by BG-372 and CSG-8961 recorded calorific value of 413.97 and 413.94 K calories, respectively. Genotypes KGD-1316 showed the lowest calorific value 409.87 K calories of chickpea. Kabuo *et al.* (2015) [9] reported variability in calorific value in gram ranged from 345.6 to 450.67kcal/g of chickpea.

Table 1: Protein content and total carbohydrate content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

Varieties/genotypes	Protein content			Total carbohydrate content		
	Mean		Pooled Mean	Mean		Pooled Mean
	2018-2019	2019-2020		2018-2019	2019-2020	
Vijay	22.56	22.58	22.57	69.38	69.32	69.35
BG-256	22.56	22.53	22.545	69.44	69.51	69.475
JG-16	22.28	22.32	22.3	69.43	69.41	69.42
CSG-8961	22.88	22.84	22.86	69.08	69.16	69.12
BG-372	22.91	22.89	22.9	69	69.01	69.005
K-3256	23.45	23.42	23.435	68.44	68.52	68.48
KWR-108	23.36	23.33	23.345	68.68	68.69	68.685
KPG-59	22.56	22.58	22.57	69.38	69.42	69.4
Radhey	22.07	22.12	22.095	69.65	69.65	69.65
Avarodhi	22.87	22.89	22.88	68.84	68.86	68.85
KGD-1288	22.64	22.68	22.66	69.31	69.34	69.325
KGD-1295	22.89	22.84	22.865	69.24	69.35	69.295
KGD-1296	22.19	22.24	22.215	70.13	70.16	70.145
KGD-1302	22.09	22.14	22.115	70.18	70.14	70.16
KGD-1315	22.16	22.19	22.175	70.2	70.22	70.21
KGD-1316	23.34	23.29	23.315	69.04	69.09	69.065
KGD-2012	22.46	22.48	22.47	69.89	69.83	69.86
Pusa-209	21.97	22.03	22	70	69.98	69.99
Pusa-391	23.05	23.07	23.06	69.4	69.33	69.365
RBG-1	22.13	22.15	22.14	70.21	70.14	70.175
Mean	22.67	23.84	23.54	69.70	68.42	69.06
S.E. (m) ±	0.31	0.35	0.30	1.20	0.97	0.68
C.D. (5%)	0.89	1.01	0.86	4.18	2.91	2.02

Table 2: Fat content and Ash content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

Varieties/Genotypes	Fat content			Ash content		
	Mean		Pooled Mean	Mean		Pooled Mean
	2018-2019	2019-2020		2018-2019	2019-2020	
Vijay	6.00	6.05	6.025	2.06	2.05	2.055
BG-256	5.87	5.85	5.86	2.13	2.11	2.12
JG-16	6.13	6.10	6.115	2.16	2.17	2.165
CSG-8961	5.95	5.92	5.935	2.09	2.08	2.085
BG-372	6.01	6.04	6.025	2.08	2.06	2.07
K-3256	5.95	5.91	5.93	2.16	2.15	2.155
KWR-108	5.85	5.88	5.865	2.11	2.10	2.105
KPG-59	5.90	5.86	5.88	2.16	2.14	2.15
Radhey	6.15	6.11	6.13	2.13	2.12	2.125
Avarodhi	6.20	6.18	6.19	2.09	2.07	2.08
KGD-1288	5.93	5.89	5.91	2.12	2.09	2.105
KGD-1295	5.85	5.82	5.835	2.02	1.99	2.005
KGD-1296	5.65	5.59	5.62	2.03	2.01	2.02
KGD-1302	5.60	5.58	5.59	2.13	2.14	2.135
KGD-1315	5.50	5.47	5.485	2.14	2.12	2.13
KGD-1316	5.45	5.47	5.46	2.17	2.15	2.16
KGD-2012	5.50	5.53	5.515	2.15	2.16	2.155
Pusa-209	5.95	5.92	5.935	2.08	2.07	2.075
Pusa-391	5.45	5.49	5.47	2.10	2.11	2.105
RBG-1	5.60	5.63	5.615	2.06	2.08	2.07
Mean	4.80	4.85	4.82	2.84	2.90	2.87
S.E. (m) ±	0.08	0.07	0.07	0.05	0.04	0.04
C.D. (5%)	0.23	0.20	0.20	0.14	0.12	0.11

Table 3: Calorific value and Moisture content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

Varieties/ Genotypes	Calorific value (Kcal./100g)			Moisture content		
	Mean		Pooled Mean	Mean		Pooled Mean
	2018-2019	2019-2020		2018-2019	2019-2020	
Vijay	421.76	422.05	421.905	7.78	7.45	7.61
BG-256	420.83	420.81	420.82	6.21	6.68	6.44
JG-16	422.01	421.82	421.915	6.99	6.43	6.71
CSG-8961	421.39	421.28	421.335	7.12	6.88	7.00
BG-372	421.73	421.96	421.845	6.47	6.01	6.24
K-3256	421.11	420.95	421.03	6.93	7.19	7.06
KWR-108	420.81	421.00	420.905	6.94	6.50	6.72

KPG-59	420.86	420.74	420.8	5.56	5.97	5.76
Radhey	422.23	422.07	422.15	6.79	6.84	6.81
Avarodhi	422.64	422.62	422.63	6.81	5.72	6.26
KGD-1288	421.17	421.09	421.13	7.85	6.96	7.40
KGD-1295	421.17	421.14	421.155	6.12	6.88	6.50
KGD-1296	420.13	419.91	420.02	6.37	6.17	6.27
KGD-1302	419.48	419.34	419.41	6.14	6.78	6.46
KGD-1315	418.94	418.87	418.905	5.89	6.14	6.01
KGD-1316	418.57	418.75	418.66	6.34	5.92	6.13
KGD-2012	418.9	419.01	418.955	6.48	6.86	6.67
Pusa-209	421.43	421.32	421.375	5.94	6.43	6.18
Pusa-391	418.85	419.01	418.93	6.11	6.67	6.39
RBG-1	419.76	419.83	419.795	7.28	6.88	7.08
Mean	412.65	412.63	412.64	6.61	6.57	6.59
S.E. (m) ±	5.97	6.01	5.70	0.10	0.11	0.09
C.D. (5%)	17.89	17.97	17.06	0.29	0.31	0.27

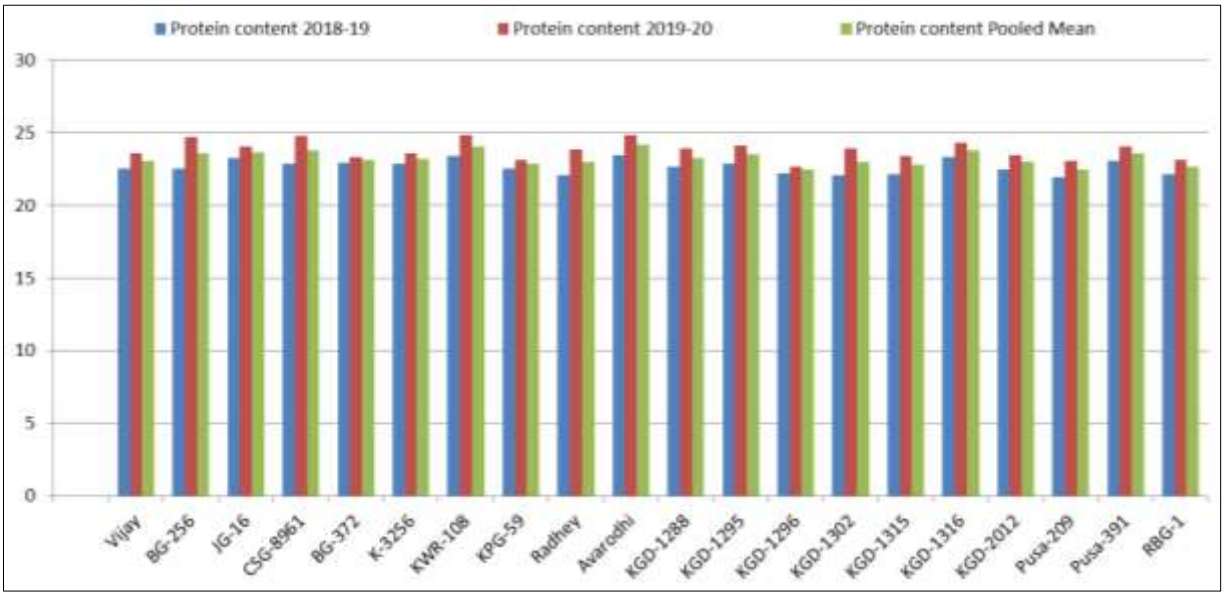

Fig 1: Protein content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

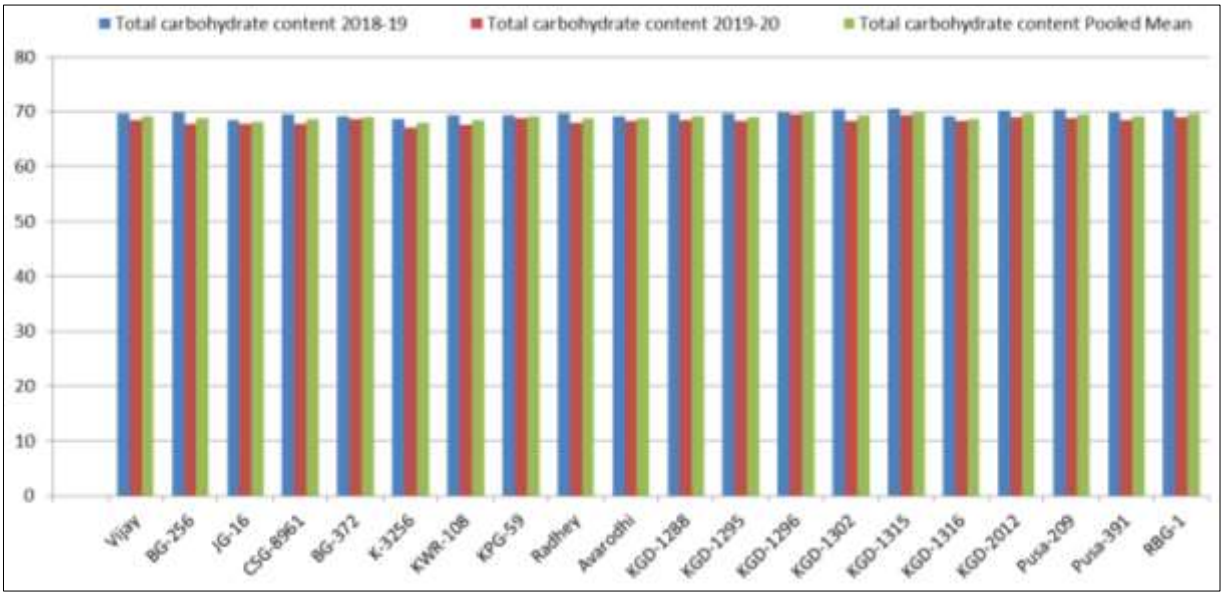

Fig 2: Total carbohydrate content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

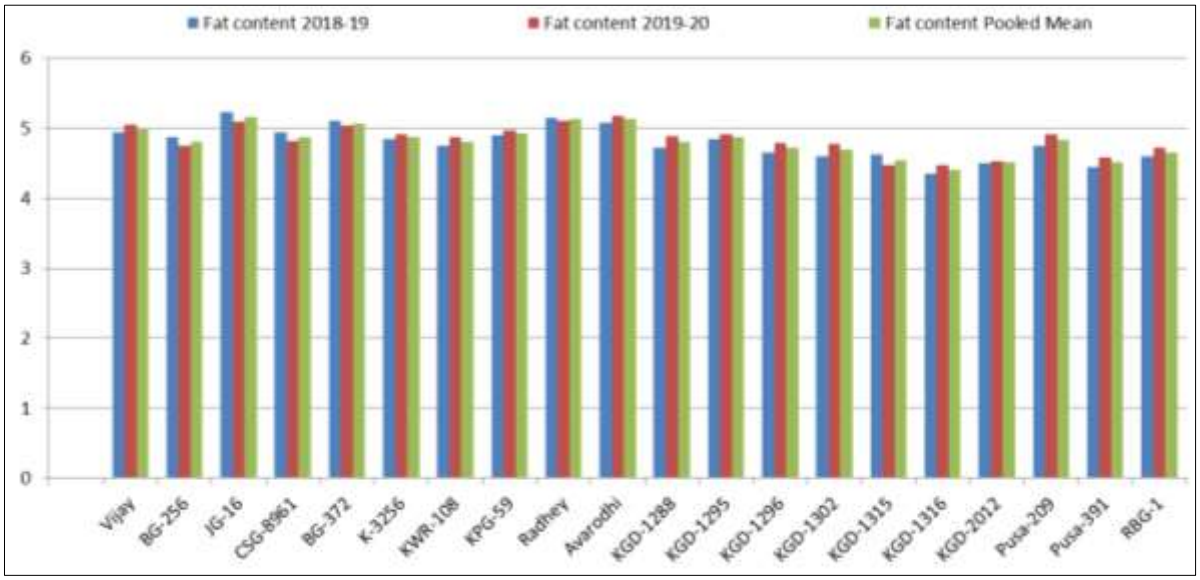

Fig 3: Fat content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

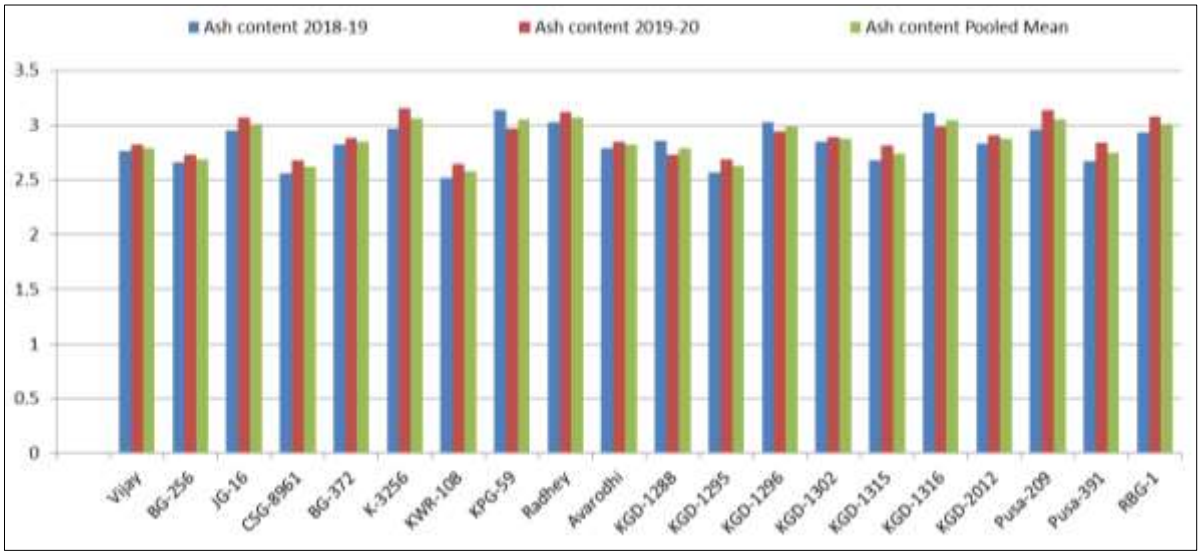

Fig 4: Ash content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

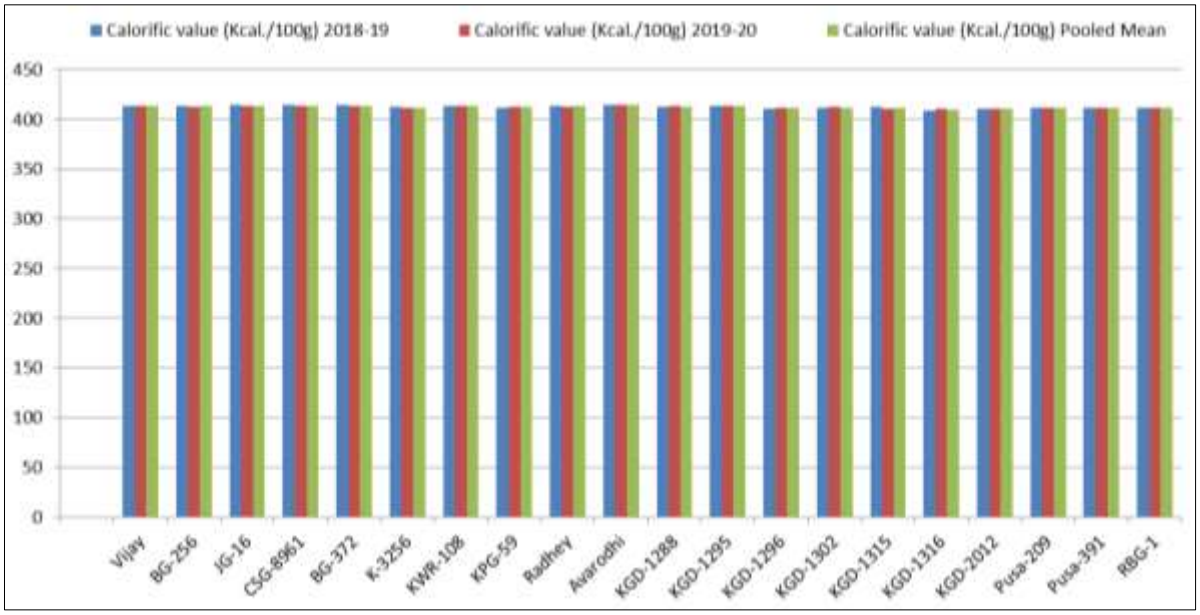

Fig 5: Calorific value of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

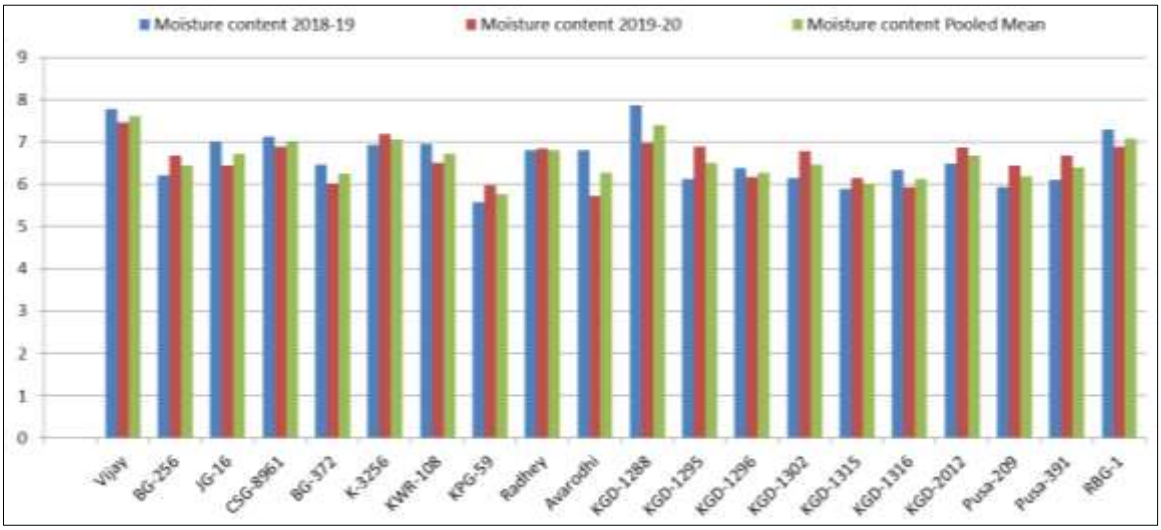

Fig 6: Moisture content of important varieties/genotypes of chickpea (*Cicer arietinum* L.)

Conclusion

Based on the results emerging out of the present investigation it may inferred that the chickpea varieties/genotypes proved beneficial increasing most of the desirable quality characteristics. Chickpea variety Avarodhi appeared to be the best having excelled in two quality characters such as protein content and calorific value, out of the six quality parameters were studied

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