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Effect of polymer coating and fungicide on biochemical constituent of Kabuli chickpea varieties

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Abstract
A laboratory experiment was carried out in the Department of Seed Science and Technology, College of Agriculture, Vijayapura, University of Agricultural Sciences, Dharwad during 2017-18 to study the effect of seed polymer coating along with fungicide on biochemical constituent of kabuli chickpea varieties during storage. The variety MNK 1 showed better storage performance as compared to KAK 2. Among the seven different treatments *viz*; control, polymer 10 ml/kg seed, polymer 20 ml/kg seed, vitavax 3 g/kg seed, polymer (10 ml/kg of seed) + vitavax power (3 g/kg of seed), polymer (20 ml/kg of seed) + vitavax power (3 g/kg of seed) and castor oil (10 ml/kg seed) the kabuli chickpea seeds treated with polymer (20 ml/kg of seed) + vitavax power (3g/kg of seed) recorded significantly higher protein content (17.92%), reducing sugar (1.28%), non-reducing sugar (9.90%) and dehydrogenase activity (0.740 OD value) upto nine months of storage followed by the treatment combination polymer (10 ml/kg of seed) + vitavax power (3 g/kg of seed). Hence the same treatment combination can be to store seeds for longer period without much deterioration.

Keywords: polymercoat, fungicide, kabuli, biochemical constituent

Introduction
Among the food crops, pulses are an important group which occupies a unique position in the world of agriculture by virtue of their high protein content. In pulses, chickpea (*Cicer arietinum* L.) is one of the important crops with high acceptability and wider use, besides being rich in protein, its ability to use atmospheric nitrogen through biological nitrogen fixation is economically sounder and environmentally acceptable grown in *Rabi* season, which belongs to the genus *Cicer,* family *Fabaceae*. The southeastern part of Turkey near Syria was the place where chickpea is accepted to have been originated (Van Der Maesen, 1984) [7].

Kabuli chickpea accounts for about 20 per cent of the world's chickpea production. Kabuli types are characterized by large seeds (more than 26- 50g per 100 seeds) that are pale cream and shaped like a ram's head or brain. Kabuli chickpea seed is sought for whole seed consumption in confectionery products, salads, savoury meals or ground into paste (hommos); hence its appearance (size and colour) is an important characteristic that can affect marketability and price.

One of the major problems encountered in kabuli chickpea production in India is lack of availability of good quality seeds at the time of planting as many of the seed lots produced losess their viability quickly. The post maturation and storage phases of seed encompass a series of deteriorative processes that can alter seed performance potential. Seed coating especially film-coating, is one such technique which has gained commercial importance owning to its practical utility as an effective delivery system for seed protectant and fortifying chemicals. Film coating is a new concept in which the plasticizer polymer forms a flexible film that adheres and protects fungicide and insecticide. The polymer coating is simple to apply, diffuses rapidly and non- toxic to the seed during germination. An experiment was conducted to determine the protein, sugars and dehydrodenase activity with kabuli chickpea varieties.

The poor storability of kabuli chickpea seeds is accounted for high protein and sugar content, physiological fragility and thin seed coat, which leads to rapid loss of viability and vigour in storage and ultimately results in poor establishment of the crop in the field and low productivity. Seed deterioration is an irreversible, inexorable and inevitable process. But the rate of seed deterioration could be slowed down either by storing the seeds under controlled conditions or by imposing seed treatment with polymer coating along with seed treatment chemicals. Seed coatings are extremely thin, which allows multiple layers on the seed with only a 1 to 10% increase in seed weight. The film coat provides a uniform, yet precise placement of chemicals at much lower rates than the traditional seed treatment systems and offers the opportunity to add many enhancement layers as needed to improve performance, flowability of the seed, essentially dust free, safe to handle and has bright color and nice appearance. Seed treatment is an efficient technology replacing wasteful foliar and soil application of chemicals. Film coating is a new concept in which the plasticizer polymer forms a flexible film that adheres and protects fungicide and insecticide. The polymer coat provides protection from the stress imposed by accelerated ageing, which includes fungal invasion. It improves plant stand and emergence of seeds, accurate application of the chemical reducing chemical wastage, helps to make room for including all required ingredients, protectants, nutrients, plant growth promoters, hydrophobic/hydrophilic substance, oxygen suppliers etc.

Better storage performance can be obtained by treating the seeds with polymers + fungicide and storing them under ambient conditions with minimum qualitative and quantitative changes, keeping this in view an experiment was conducted to know the effect of polymer coating and fungicide treatment on biochemical constituent of kabuli chickpea varieties.

Material and Methods

The storage experiment was carried out during 2017-18 consisting of two varieties and seven treatments. The kabuli chickpea varieties *viz.*, KAK 2 and MNK 1 were obtained from Plant breeder AICRP, Dryland Agriculture, RARS Vijayapura. Seeds were treated in accordance of treatment combinations *viz*; T_1: control (Untreated), T_2: polymer coat 10ml/kg seed, T_3: polymer coat 20ml/kg seed, T_4: vitavax power 3g/kg seed, T_5: polymer coat 10ml/kg seed + vitavax power 3g/kg seed, T_6: polymer coat 20ml/kg seed + vitavax power 3g/kg seed, T_7: castor oil 10ml/kg seed. One kg kabuli chickpea seeds were taken in a polythene bags and 10 ml and 20 ml of polymer per kg seed was added to it separately as per the treatment. Whereas, vitavax power 3g/kg seed was made into slurry and added to separate polythene bags and closed tightly trapping the air in it to form a balloon, then polythene bag was vigorously shaken till the seeds are uniformly coated, later the treated seeds were spread on a polythene sheet to dry under the shade. One kg of seeds were taken in a polythene bag, initially they were treated with fungicide (vitavax power) and then added polymer coat in it. The polythene bag was closed tightly trapping air in it to form a balloon and vigorously shaken till the seeds were uniformly coated, later the treated seeds were spread on a polythene sheet under the shade to dry completely and packed in cloth bag. The packed seeds were kept for storage under ambient conditions. The same procedure was used for the other seed treatment combinations also. Observations on seed quality parameters like protein content, reducing sugar and non-reducing sugar content, dehydrogenase activity were recorded upto 9 months of storage period. For determination of protein content (Lowry *et al.* (1951) [3] method was followed. Determination of reducing sugar and non-reducing sugar according to the method of Sadasivam and Manickam (1997) *i.e.*, Nelson-Somogyi method was followed. Dehydrogenase activity was determined by (Kittock and Law, 1968) [1] method. The data collected from the experiment was analysed statistically by adopting the procedures as described by Sundarrajan *et al.* (1972).

Results and Discussion

The varietal difference with respect to biochemical constituent has been observed in kabuli chickpea varieties (Table 1, 2, 3 and 4). Significant variation in the parameters was observed in kabuli chickpea varieties irrespective of treatments.

Table 1: Effect of polymer coating, chemical and castor oil treatment on protein content (%) of kabuli chickpea during storage

Treatments	Initial month			3rd month			6th month			9th month		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1	20.11	21.18	20.65	18.35	19.21	18.78	17.34	18.20	17.77	16.33	17.19	16.76
T_2	20.21	21.3	20.76	18.60	19.52	19.06	17.59	18.51	18.05	16.59	17.51	17.05
T_3	20.23	21.39	20.81	18.71	19.66	19.19	17.71	18.65	18.18	16.70	17.65	17.17
T_4	20.3	21.51	20.91	18.95	19.84	19.39	17.94	18.84	18.39	16.93	17.83	17.38
T_5	20.53	21.62	21.08	19.00	20.27	19.63	17.99	19.26	18.63	16.98	18.25	17.62
T_6	20.58	21.67	21.13	19.21	20.66	19.94	18.20	19.65	18.93	17.19	18.65	17.92
T_7	20.14	21.28	20.71	18.52	19.42	18.97	17.51	18.41	17.96	16.51	17.41	16.96
V Mean	20.3	21.42	20.86	18.76	19.80	19.28	17.75	18.79	18.27	16.75	17.78	17.27
	S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)	
V	0.127	0.485		0.096	0.367		0.091	0.348		0.086	0.329	
T	0.238	NS		0.180	0.687		0.171	0.652		0.161	0.616	
V × T	0.336	NS		0.255	NS		0.242	NS		0.228	NS	

Note: V_1-KAK 2, V_2 – MNK 1
NS - Non significant
T_1 Control (untreated).
T_2 Polymercoat @ 10 ml/kg of seeds.
T_3 Polymercoat @ 20 ml/kg of seeds.
T_7 Castor oil @ 10 ml/ kg of seed
T_4 Vitavax power @ 3 g/kg of seeds (Carboxin 37.5 % + Thiram 37.5 %).
T_5 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 10 ml/kg of seeds.
T_6 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 20 ml/kg of seeds.

Table 2: Effect of polymer coating, chemical and castor oil treatment on non-reducing sugar content of kabuli chickpea during storage

Treatments	Non -reducing sugar (%)											
	Initial month			3rd month			6th month			9th month		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1	9.46	10.88	10.17	9.04	10.27	9.65	8.37	9.69	9.03	7.98	9.14	8.56
T_2	9.49	10.91	10.21	9.30	10.45	9.88	8.89	10.07	9.48	8.35	9.70	9.03
T_3	9.50	10.95	10.22	9.33	10.59	9.96	9.00	10.36	9.68	8.66	9.99	9.33
T_4	9.52	11.03	10.28	9.48	10.86	10.17	9.21	10.61	9.91	8.88	10.26	9.57
T_5	9.58	11.04	10.31	9.51	10.91	10.21	9.30	10.72	10.01	9.04	10.48	9.76
T_6	9.64	11.09	10.36	9.58	11.00	10.29	9.34	10.78	10.06	9.11	10.69	9.90

T_7	9.48	10.90	10.19	9.25	10.38	9.82	8.68	9.86	9.27	8.15	9.43	8.79
V Mean	9.53	10.97	10.25	9.36	10.63	10.00	8.97	10.30	9.63	8.60	9.96	9.28
	S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)	
V	0.032	0.122		0.061	0.233		0.059	0.224		0.057	0.216	
T	0.060	NS		0.114	0.435		0.110	0.420		0.106	0.404	
V × T	0.085	NS		0.161	NS		0.156	NS		0.150	NS	

Note: V_1-KAK 2, V_2 – MNK 1
NS - Non significant
T_1 Control (untreated).
T_2 Polymercoat @ 10 ml/kg of seeds.
T_3 Polymercoat @ 20 ml/kg of seeds.
T_7 Castor oil @ 10 ml/ kg of seed
T_4 Vitavax power @ 3 g/kg of seeds (Carboxin 37.5 % + Thiram 37.5 %).
T_5 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 10 ml/kg of seeds.
T_6 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 20 ml/kg of seeds.

Table 3: Effect of polymer coating, chemical and castor oil treatment on reducing sugar content (%) of kabuli chickpea during storage

Treatments	Reducing sugar (%)											
	Initial month			3rd month			6th month			9th month		
	V_1	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**
T_1	1.23	1.51	1.37	1.18	1.46	1.32	1.02	1.26	1.14	0.76	0.98	0.87
T_2	1.23	1.52	1.38	1.20	1.50	1.35	1.11	1.31	1.21	0.90	1.17	1.04
T_3	1.24	1.53	1.39	1.21	1.51	1.36	1.13	1.37	1.25	0.94	1.21	1.08
T_4	1.26	1.55	1.41	1.24	1.53	1.39	1.19	1.42	1.31	1.02	1.33	1.18
T_5	1.27	1.56	1.42	1.25	1.54	1.40	1.20	1.47	1.34	1.06	1.39	1.22
T_6	1.28	1.57	1.43	1.26	1.55	1.41	1.23	1.50	1.37	1.14	1.41	1.28
T_7	1.23	1.52	1.38	1.19	1.49	1.34	1.09	1.30	1.20	0.82	1.09	0.96
V Mean	1.25	1.54	1.40	1.22	1.52	1.37	1.14	1.38	1.26	0.95	1.23	1.09
	S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)	
V	0.009	0.033		0.008	0.032		0.008	0.029		0.006	0.023	
T	0.016	NS		0.016	0.060		0.014	0.055		0.011	0.044	
V × T	0.023	NS		0.022	NS		0.020	NS		0.016	NS	

Note: V_1-KAK 2, V_2 – MNK 1
NS - Non significant
T_1 Control (untreated).
T_2 Polymercoat @ 10 ml/kg of seeds.
T_3 Polymercoat @ 20 ml/kg of seeds.
T_7 Castor oil @ 10 ml/ kg of seeds
T_4 Vitavax power @ 3 g/kg of seeds (Carboxin 37.5 % + Thiram 37.5 %).
T_5 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 10 ml/kg of seeds.
T_6 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 20 ml/kg of seeds.

Table 4: Effect of polymer coating, chemical and castor oil treatment on dehydrogenase activity (OD value) of kabuli chickpea during storage

Treatments	Initial month			3rd month			6th month			9th month		
	V_1	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**	**V_1**	**V_2**	**Mean**
T_1	0.615	0.844	0.729	0.603	0.827	0.715	0.585	0.798	0.692	0.574	0.789	0.682
T_2	0.634	0.853	0.743	0.621	0.848	0.734	0.606	0.813	0.709	0.592	0.801	0.697
T_3	0.637	0.855	0.746	0.625	0.850	0.737	0.613	0.817	0.715	0.604	0.803	0.703
T_4	0.656	0.863	0.759	0.649	0.857	0.753	0.634	0.837	0.736	0.626	0.831	0.729
T_5	0.663	0.867	0.765	0.654	0.859	0.756	0.643	0.845	0.745	0.639	0.834	0.737
T_6	0.671	0.875	0.773	0.663	0.868	0.765	0.654	0.849	0.751	0.646	0.835	0.740
T_7	0.628	0.850	0.739	0.614	0.834	0.724	0.598	0.806	0.702	0.587	0.794	0.691
V Mean	0.643	0.858	0.751	0.632	0.849	0.741	0.619	0.824	0.721	0.610	0.812	0.711
	S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)		S.Em.±	C.D.(P=0.01)	
V	0.005	0.018		0.005	0.017		0.004	0.017		0.004	0.017	
T	0.009	0.033		0.009	0.033		0.008	0.032		0.008	0.031	
V × T	0.012	NS		0.012	NS		0.012	NS		0.012	NS	

Note: V_1-KAK 2, V_2 – MNK 1, NS - Non significant
T_1 Control (untreated).
T_2 Polymercoat @ 10 ml/kg of seeds.
T_3 Polymercoat @ 20 ml/kg of seeds.
T_7 Castor oil @ 10 ml/ kg of seeds.
T_4 Vitavax power @ 3 g/kg of seeds (Carboxin 37.5 % + Thiram 37.5 %).
T_5 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 10 ml/kg of seeds.
T_6 Vitavax power @ 3 g/kg of seeds + Polymercoat @ 20 ml/kg of seeds.

Protein content (%)

Irrespective of varieties and seed treatments, the protein content was declined progressively as the storage period advanced. The mean protein content was decreased from 20.86 % to 17.27 % in the initial and at the end of ninth month, respectively. The significant difference was noticed on protein content due to the varieties during storage period of nine months. Significantly, the maximum protein content at initial and nine month of storage period (21.42 and 17.78 %, respectively) was recorded in MNK 1 and it was followed by KAK 2 (20.30 and 16.75 %, respectively).

Due to seed treatments, the significant difference in protein content was recorded from third month to ninth month of storage period. Significantly maximum protein content (19.94 %) was noticed at third month in vitavax power @ 3 g/kg seed + polymercoat @ 20 ml/kg of seeds and it was followed by the vitavax power @ 3 g/kg seed + polymercoat @ 10 ml/kg of seeds as 19.63 % and minimum protein content (18.78 %) was recorded in untreated. Similar trend was noticed up to ninth month of storage period. At the end of ninth month of storage period, significantly maximum protein content (17.92 %) was recorded in vitavax power @ 3 g/kg seed + polymercoat @ 20 ml/kg of seeds and it was followed by vitavax power @ 3 g/kg seed + polymercoat @ 10 ml/kg of seeds (17.62 %), while significantly minimum protein content (16.76 %) was recorded in untreated. The pattern of reduction in the protein content may be related to oxidation of the amino acids, due to increase in the respiratory activity. The decline in protein content was more in control than the polymer and fungicide coated seeds because of fungal invasion, insect attack, fluctuating temperature, relative humidity, leaching of seed reserves. These results are in conformity with the findings of Siddaraju *et al.* (2015) [5] in hybrid maize and Laxman *et al.* (2017) [2] in chickpea.

Non-reducing and reducing sugar content (%)

Irrespective of varieties and seed treatments, the non-reducing and reducing sugar content was declined progressively as the storage period advanced. The mean non-reducing sugar content from 10.25 to 9.28 % and reducing sugar content from 1.40 to 1.09 % decreased in the initial and at the end of ninth month, respectively. The significant difference was noticed on non-reducing and reducing sugar content due to the varieties during storage period of nine months. Significantly, the maximum non-reducing sugar content (10.97 and 9.96 %) and reducing sugar (1.54 and 1.23 %) at initial and ninth month of storage period respectively was recorded in MNK 1 and it was followed by KAK 2 *i.e.*, non-reducing sugar content (9.53 and 8.60 %) and reducing sugar (1.25 and 0.95 %) at initial and ninth month of storage period respectively.

Due to seed treatments, the significant difference in non-reducing and reducing sugar content was recorded from third month to ninth month of storage period. Significantly maximum non- reducing sugar content (10.29 %) and reducing sugar content (1.41 %) was noticed at third month in vitavax power @ 3 g/kg seed + polymercoat @ 20 ml/kg of seeds and it was followed by vitavax power @ 3 g/kg seed + polymercoat @ 10 ml/kg of seeds as 10.21 and 1.40 %. The minimum non- reducing sugar content (9.65 %) and reducing sugar content (1.32 %) was recorded in untreated. Similar trend was noticed up to nine months of storage period. At the end of ninth month of storage period, significantly maximum non- reducing sugar content (9.90 %) and reducing sugar content (1.28 %) was noticed at 9th month in vitavax power @ 3 g/kg seed + polymercoat @ 20 ml/kg of seeds and it was followed with the vitavax power @ 3 g/kg seed + polymercoat @ 10 ml/kg of seeds as 9.76 and 1.22 %, while significantly minimum non-reducing sugar content (8.56 %) and reducing sugar content (0.87 %) and was recorded in untreated. The reduction in the reducing and non-reducing sugars may be related to increase in electrical conductivity, attributed to permeability of the seed membrane as seed ages, many substances such as sugars decreases and also due to genetic factors, fungal invasion, insect attack, fluctuating temperature, relative humidity and increase in moisture content. These results are in agreement with the reports of Laxman *et al.* (2017) [2] in chickpea.

Dehydrogenase activity (OD value)

Irrespective of varieties and seed treatments, the dehydrogenase activity was declined progressively as the storage period advanced. The mean dehydrogenase activity was decreased from 0.751 to 0.711 OD value in the initial and at the end of ninth month, respectively. The significant difference was noticed on dehydrogenase activity due to the varieties during storage period of nine months. Significantly, the maximum dehydrogenase activity at initial and nine month of storage period (0.858 and 0.812 OD value, respectively) was recorded in MNK 1 and it was followed by KAK 2 (0.643 and 0.610 OD value, respectively).

Due to seed treatments, the significant difference in dehydrogenase activity was recorded from initial month to ninth month of storage period. Significantly maximum dehydrogenase activity (0.773 OD value) was noticed at initial month in vitavax power @ 3 g/kg seed + polymercoat @ 20 ml/kg of seeds and it was on par with the vitavax power @ 3 g/kg seed + polymercoat @ 10 ml/kg of seeds as 0.765 OD value and minimum dehydrogenase activity (0.729 OD value) was recorded in untreated. Similar trend was noticed up to nine months of storage period. At the end of ninth month of storage period, significantly maximum dehydrogenase activity (0.740 OD value) was recorded in vitavax power @ 3 g/kg seed + polymercoat @ 20 ml/kg of seeds and it was followed by vitavax power @ 3 g/kg seed + polymercoat @ 10 ml/kg of seeds (0.737 OD value), while significantly minimum dehydrogenase activity (0.682 OD value) was recorded in untreated.

The interaction effects due to varieties and seed treatments showed a non significant difference upto the end of storage period. However, numerically maximum dehydrogenase activity was noticed in the V_2T_6 (0.835 OD value) followed by V_2T_5 (0.834 OD value) on par with V_2T_4 (0.831 OD value) and the lowest was in V_1T_1 (0.574 OD value) at the end of storage. The decrease in dehydrogenase activity throughout the storage period might be due to the activity of enzyme responsible for respiration of the seed reduced with the age of the seeds and glucose utilization was reduced in the deteriorated seeds which are reflected through lower dehydrogenase activity. These results are in agreement with the reports of Siddaraju *et al.* (2015) [5] in hybrid maize.

It can be concluded from the results that, MNK 1 seeds store better with good seed quality than the KAK 2. Large quantity of seed can be stored for longer period, with superior seed quality by treating the seeds with vitavax power 3 g/kg seed + polymercoat 20 ml/kg of seed.

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