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Performance Evaluation of Grain Storage in Hermetic Bag

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A B S T R A C T

Grain storage is mainly done to reduce the grain loss which can be caused by insect attack, mold growth, moisture content and other contaminations. Various methods are used by the farmers to store the grains i.e. indoor and outdoor structures, containers, underground storage, aerial storage etc. However every method has its own advantages and disadvantages. Hermetic bag is a new concept to store the grains which can be used in individual houses for their yearlong consumption as many people both in rural and urban areas purchase grains in bulk as big buys cost less and store it at home either in plastic or metal containers or gunny bags. However to avoid the insect attack they do sun drying once in a while, add fungicide tablets or boric powder, neem leaves etc. To simplify their task of periodical checking, to protect the grains from insect attack and avoid the contamination of grains with chemicals, hermetic bag was designed and developed and tested under laboratory conditions. The results revealed that it was effective in storing the grains with low moisture content, absence of

Introduction

Grain storage is a major challenge for the farmers to reduce the loss of quality and nutritional value. Losses during storage are caused by moisture content, insects and molds which reduce seed weight and can destroy the nutritional quality of the seed under high temperature and humidity (Williams *et al.*, 2017). Synthetic pesticides/ insecticides/ rodenticides are not a good option to control the pests/rodents/insects.

Traditionally grains were stored in different types of containers. a) Vertical grass structures constructed outside the house with bamboo sticks or locally available reeds/dry grasses. It is usually circular in shape with a raised base made of bricks/reeds, which protects the grain from rat damage and

prevents moisture absorption from the ground. The roof also covered with dry grass/ patch. However, this is mainly used for storing grains in large quantity. B) Earthen pots are indoor storage containers for storing the grains for household consumption. These are available for different shapes and sizes. C) Grain storage containers made of local reeds plastered with mud and dry leaves which acts as insect repellent. It is also circular in shape usually of 5-6 feet height.

Another method of storing grains in the households for their annual consumption is by using hermetic bags. These bags eliminate the exchange of gases within the bag and mitigate bacterial activity and insect infestation. In this method, the grain is stored inside the sealed compartment.

Purdue Improved Crop Storage (PICS) bags were field tested in storing sorghum seed for six months in Africa and found that these bags maintained its initial moisture level, germination rate and seed weight (Williams *et al.*, 2017).

Darby and Caddick (2007) analyzed and field evaluated the harvest bag technology in Australia. It was observed that reliable insect disinfestation capability with harvest bags is not available and insects detected at outturn pose considerable logistical problems.

In the present study double layered hermetic grain storage bags was designed two layers. Outer layer was made of polypropylene material and inside layer with 20 microns plastic bag made of polythene (Fig 1). Together, these two layers severely restrict the oxygen flow into the grain from the surrounding airspace thus insect growth is arrested. These are designed in different sizes i.e., 5-50 Kgs. Since the grains are stored without using any preservatives, they are safe to consume and doesn't harm the environment. These bags are reusable and doesn't require much space. Pigeon pea (Whole red gram) was tested by storing in this hermetic bag at laboratory level with two objectives i.e. 1) to evaluate the performance of hermitic storage bags in storing the grains 2) to study the sensory evaluation of the stored grains.

Materials and Methods

Experimental research design was selected for testing the performance evaluation of hermetic bags for storing whole red gram (Pigeon Pea) PRG 176 grown in university farm on following parameters:

1. Moisture content and dry matter content
2. Absence of insects
3. Germination test
4. Cooking quality

Three bags were taken up for the study i.e. normal plastic bag, hermetic bag 1 with 10 microns polythene inner layer (bag 1) and hermetic bag 2 with 20 microns polythene inner layer (bag 2).

Moisture content and dry matter content

Whole Red gram was stored in hermetic bags to evaluate the moisture content, spoilage of seeds, cooking quality and germination by naming them as control, bag 1 and bag 2.

Red gram was subjected to moisture and dry matter analysis as per AOAC (2005) protocols. The moisture content was determined for all the three samples by measuring weight loss of measured sample in a ConTECHmoisture analyser by desiccation in an oven maintained at 105°C until constant weight. The dry matter content was estimated as the difference of sample weight and moisture content.

$$\text{Moisture content (\%)} = \frac{Initial\ weight - Final\ weight}{Initial\ weight} x100$$

Absence of insects

Visual inspection was done regularly every month for a period of 10 months.

Germination rate

Standard procedure of germination test was conducted and rating was calculated by using the formula: No. of seeds sprouted/ No. of seeds chosen for germination x 100.

Cooking quality

A standard 9 point hedonic scale was used to evaluate the cooked whole red gram in terms of colour, appearance, flavor, taste, texture and overall acceptability. Scores were based on a hedonic scale of 1 to 9 where 1= I dislike extremely (Very bad) and 9 = I like extremely (excellent) (Meilgaard *et al.*, 1999) by selecting 20 members from AICRP and PG&RC, PJTSAU to do the organoleptic evaluation.

Results and Discussion

The results of the study were presented below in detail

Moisture and dry matter analysis revealed that in control method, percentage result was found to be 0.090% within 105 seconds at 100^0c whereas in bag (0.110%) and bag 2 (0.143%) within 90 seconds at 100^0c (Fig 2). Further analysis was done to test the significant relationship between dry and wet weight of all three bags (Table 1).

When compared the moisture content value of pigeon pea in controlled method and bag 1 method, the results revealed that there was a significant relationship between wet weight and dry weight (Table 2).

However, there was no significant relationship found between the moisture content of controlled method and bag 2 method (Table 3).

Similar results were found when moisture content value was compared in between bag 1 and bag 2 method i.e. no significant relationship (Table 4).

Absence of insects

No insects were observed in the hermetic bags inside the seeds when used for cooking test after 10 months of storage period. There was no contamination by insects during the study period both in bag 1 and bag 2 which were physically observed (Fig 4). However in the controlled method, grains were fully infested with insects (Fig 3).

Germination test was done by soaking red gram in water for 12 hours under cool conditions. Then water was drained, kept the soaked red gram in a muslin cloth and tied it firmly and kept the bag in dark area for 12 more hours. It was found that sprouting was seen after 12 hours of tyeing the grain in the bag (Fig 5). Seed germination was calculated by using the formula

$$\text{Germinated seeds (\%)} = \frac{Number\ of\ seeds\ sprouted}{Number\ of\ seeds\ chosen\ for\ germination} x100$$

Through germination test it was found that germination rate was nearly 75% in bag 2 while it was very low in control method i.e. 48% (Table 5). It implies that if bag thickness is more as in the case of bag 2, germination rate was better compared to bag 1 and control method. The reason might be s the insect attack or moisture content was more in those bags due to which grain germination was low.

Cooking quality

A detailed investigation on sensory parameters of whole red gram has been carried out. The results of the study were discussed below in detail.

The sensory evaluation of whole red gram stored in different hermetic bags was done to test its acceptability. The mean scores obtained for various sensory attributes were presented table 6.

Table 1. Mean values of moisture content and dry matter content of Pigeon Pea

	Control	**Bag 1**	**Bag 2**
Wet weight (g)	4.993	5.045	5.062
Dry weight (g)	4.988	5.039	5.055
Result (%)	0.090	0.110	0.143
Time (Sec)	105.0	90.00	90.00
Temp (^{0}c)	100	100	100
Mode	Auto	Auto	Auto

Table.2 Comparision between moisture content value in both control and Bag 1

Moisture content	Control		Bag 1		t-value	P-value
	Mean	S.D	Mean	S.D		
Wet weight (g)	4.993	0.010	5.045	0.005	6.20**	0.025
Dry weight (g)	4.988	0.008	5.039	0.008	6.32**	0.024
Result (%)	0.090	0.072	0.110	0.05	1.00^{ns}	0.423
Time (Sec)	105.0	21.79	90.00	10.0	-1.96^{ns}	0.188

Table .3 Comparision between moisture content value in both control and Bag 2

Moisture content	Control		Bag 2		t-value	P-value
	Mean	S.D	Mean	S.D		
Wet weight (g)	4.993	0.010	5.062	0.027	3.115 ^{ns}	0.089
Dry weight (g)	4.988	0.008	5.055	0.027	3.284 ^{ns}	0.082
Result (%)	0.090	0.072	0.143	0.030	0.900 ^{ns}	0.463
Time (Sec)	105.0	21.79	90.00	10.00	-1.73 ^{ns}	0.225

Table.4 Comparision between moisture content value in both Bag1 and Bag 2

Moisture content	Bag 1		Bag 2		t-value	P-value
	Mean	S.D	Mean	S.D		
Wet weight (g)	5.045	0.005	5.062	0.027	-1.231 ^{ns}	0.343
Dry weight (g)	5.039	0.008	5.055	0.027	-1.236 ^{ns}	0.342
Result (%)	0.110	0.05	0.143	0.030	-0.714 ^{ns}	0.549
Time (Sec)	90.00	10.0	90.00	10.00	0.000 ^{ns}	1.00

Table.5 Germination test of pigeon pea in both control and experimental methods

Combinations	Seeds Sprouted	Seeds chosen for germination	Germination rate %
Control	72	150	48.0%
Bag 1	101	150	67.3%
Bag 2	112	150	74.7%

Table.6 Mean values of sensory parameters of whole red gram stored in different hermetic bags

Combinations	Colour	Appearance	Flavour	Taste	Texture	Overall acceptability
Control	7.10±1.41	7.30±0.92	7.20±1.00	7.25±1.37	7.25±1.11	7.70±1.03
Bag 1	6.50±1.63	6.25±1.58	6.4±1.98	6.75±1.18	6.6±1.90	6.45±1.82
Bag 2	6.75±1.44	6.95±1.31	6.7±1.30	6.65±1.49	7.05±1.53	6.55±1.87
Mean	6.78	6.83	6.76	6.88	6.96	6.9
S.E of mean	0.19	0.17	0.19	0.20	0.20	0.21
Confidence level at 95%	0.38 ^{ns}	0.35 ^{ns}	0.38 ^{ns}	0.41 ^{ns}	0.40^{ns}	0.43^{ns}

Experimental Method		**Control Method**					
		Colour	Appearance	Flavour	Taste	Texture	Overall acceptability
Bag 1 Method	Colour	0.364	0.487*	0.543*	0.714**	0.474*	0.685**
	Appearance	0.224	0.485*	0.528*	0.672**	0.557*	0.660**
	Flavour	0.135	0.448*	0.38	0.367	0.546*	0.345
	Taste	0.583**	0.679**	0.333	0.432	0.629**	0.608**
	Texture	0.447*	0.611**	0.292	0.706**	0.569**	0.687**
	Overall acceptability	0.781**	0.824**	0.15	0.501*	0.666**	0.637**
Bag2 Method	Colour	0.503*	0.729**	0.181	0.378	0.789**	0.547*
	Appearance	0.428	0.792**	0.326	0.532*	0.903**	0.647**
	Flavour	0.247	0.517*	0.450*	0.663**	0.669**	0.596**
	Taste	0.491*	0.651**	0.294	0.609**	0.621**	0.679**
	Texture	0.653**	0.730**	0.163	0.443	0.635**	0.640**
	Overall acceptability	0.674**	0.720**	0.19	0.577**	0.558*	0.688**

****Correlation is significant at the 0.01 level**
***Correlation is significant at the 0.05 level**

Figure.1 Hermetic grain storage bag

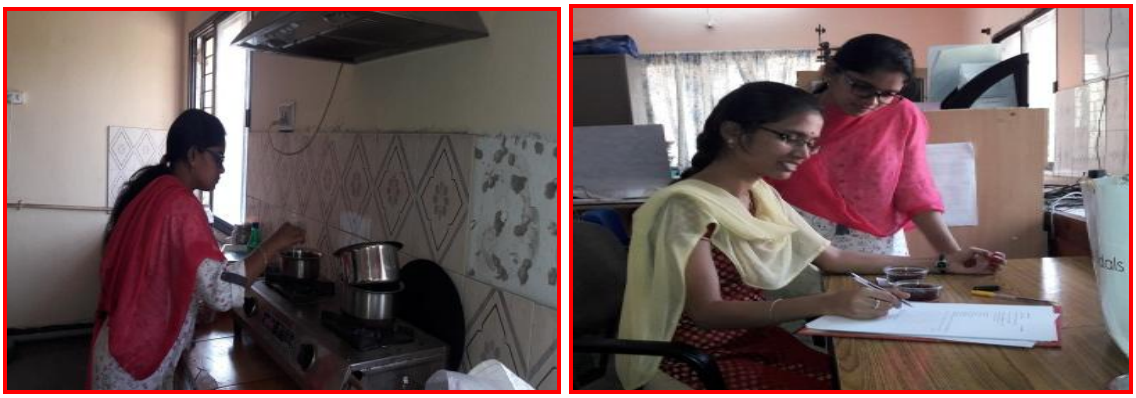
Figure.2 Moisture content values of pigeon pea

Figure.3 Insecticide in normal packaging

Figure.4 Absence of Insecticide in Hermetic Bag

Figure.5 Whole red gram germination

Figure.6 Cooking quality and Sensory evaluation of pigeon pea



When compared to control method, there was a decline in the colour of whole red gram that was stored in Bag 2 as per sensory evaluation. However, there was an increase in scores for appearance, flavor, taste, texture and overall acceptability of Red gram dhal that was stored in Bag 2. Although the mean sensory scores of whole red gram for different parameters were lower than that of control, they were acceptable because the mean sensory scores given by the panelists correspond to the parameter 'like moderately' on a hedonic scale. No significant relationship was found when compared among control, bag 1 and bag 2 methods.

Correlation was observed between the control method, Bag 1 method and Bag 2 method with sensory parameters i.e., colour, appearance, flavor, taste, texture and overall acceptability (Fig 6). In control method, appearance was found to be significantly correlated at 1 per cent level (0.01) whereas texture and overall acceptability was found at 5 per cent level (0.05). In Bag 1 method, taste was found to be significantly correlated whereas in bag 2, texture was found to be significantly correlated at 0.05 level (Table 7).

Thus it can be concluded that hermetic bag can be recommended for storing grains as it protects from insect attack and moisture retention. It had retained the germination value of grains up to 75 % and cooking quality was also good. Though experiment was done with storing of pigeon pea, any other cereal or pulse can be stored and

preserved in this bag. It has an advantage of occupying less space and can be used by small to large farm households to store the grains without polluting the environment.

References

AOAC. Official Methods of Analysis. 18th edn. Association of Official Analytical Chemists; Arlington, VA, USA: 2005.

Darby, J.A and Caddick, L.P. 2007. Review of grain harvest bag technology under Australian conditions. CSIRO Entomology. Pp. 42-48. http:// www.csiro.au/org/Entomology.html.

Williams, S.B., Murdock, L.L., Baributsa, D. 2017. Storage of maize in purdue improved crop storage (PICS) bags. PLoS One 12(1). E0168624.

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