

Original Research Article

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Effect of Hermetic Storage on Microbial and Color Quality of Green Gram

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ABSTRACT

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The present research was carried out to investigate the effect of packing materials (Hermetic bag, 300 PP bag, 200 PP bag, White plastic bag and gunny bag) and grain moisture content at packing (13%) on quality of Green gram cereals for Six months of storage in the laboratory of Farm Structures, Dr. PDKV Agriculture University Akola, Maharashtra. The quality characters (microbiological and color analysis) were determined throughout the storage period and the changes in the quality of stored grain were evaluated in terms of these variables. When the gunny, white plastic and 200 PP bags were used as the packing material, it is clear finding that 300 gauge poly propylene bag is better packaging material as far as spoilage due to bacteria is concerned that is followed by white PP-HDPE woven bag. At the same time, hermetic bags were having highest bacterial load. In the study the results found that the maximum delta E value 44.28 color deviation in 200 PP bag and hermetic bag and minimum in delta E value 42.75 color deviation in 300 PP bag. Hence it was significantly color difference in different type of storage material

Introduction

Although whole mung beans are also occasionally used in Indian cuisine, beans without skins are more commonly used; but in Kerala & Tamil Nadu, whole mung beans are commonly boiled to make a dry preparation often served with rice gruel. Dehulled mung beans can also be used in a similar fashion as whole beans for the purpose of making sweet soups. Mung beans in some regional cuisines of India are stripped of their outer coats to make mung *dal*. India is the leading producer and importer of pulse in the world. Post-

harvest loss is very high in India with losses during storage around 5 to 10%. This situation demands the development of storage guidelines for pulses to provide information to farmers on how long storage is possible without deterioration.

Environmental condition is also one of the most important factors for quality control both in production and storage level. Among the environmental factors the relative humidity and temperature are most important for storing seed. Analysis of climatological data indicates that the climate of Bangladesh is hot and

humid during most of the part of the year. According to Justice and Bass (2012) when in storage condition the moisture content of seed goes above 8-9% then the risk of insect, fungal and bacterial attack increases. So, maintain the quality of seed it is desirable to maintain the moisture content and temperature of seed storage environment within a desired range.

A few studies have shown that a significant part of the pulses grain quality deterioration have been connected with insufficient storage systems and climatic conditions for example, high moisture content, dampness and temperatures (Ahmad *et al.*, 1998). Insect infestation in grain during storage (Linda and Obermeyer, 2006; Neethirajan *et al.*, 2007), waste items created by rodents (Drummond, 2001) and the fungal attack in the stored grain are identified to lead to serious deterioration of grain (Ramaswamy *et al.*, 2009), which can further prompt sick wellbeing of the customers (Bennett and Klich, 2003). Chemical investigation of insects damaged grains has indicated substantial deterioration of nutrients like starches, vitamins and minerals (Daniel *et al.*, 1977), which may prompts undesirable tastes and off-smells making the products inadmissible and in addition unfit for utilization (Hansel *et al.*, 2004). Fungal infestation brings about decrease of grain quality, for example, changes in shade, taste, smell, nourishing worth, germination capacity and prompts the generation of distinctive metabolites which are poisonous in nature (White and Jayas, 1993).

In Dr. PDKV, Akola, practically no work has been done so far to improve grain storage methods as well as to develop grain storage structures particularly at farmer level. Absence of suitable storage structures is one of the main problems at the farm which results in substantial losses of food grain. Thus, the objective of the present experiment is to assess

the microbial and colour performance of the Hermetic grainpro bag versus the different traditionally Packaging material used room type store on green gram grain quality.

Storage structure is regarded as most important factor in handling and storage of grains as farmers require some facilities to store their produce. The important function of any storage structure is to offer high protection from insect, pests, rodents, birds etc., and it must be able to provide hermetic conditions to the stored products as well as easier to fill and empathize it. Most of the losses in grains occur in storage because poor farmers could not afford high construction costs and use cheap, inadequate structures to store their grains (Obetta and Daniel, 2007). This necessitates improvement of the storage technologies.

Materials and Methods

Experimental area

The research was conducted for six month from Oct 2016 to April 2017 at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Collection of sample

The Green gram used in the present study was procured from local market of Akola. The seed was cleaned manually and foreign matter such as stones, straw, and dirt were removed. The moisture content of the grain was determined using a Constant-temperature oven. The green gram samples was packed in different type packaging materials hermetic bag (the GrainPro Super Bags) are intended for safe storage of dry seeds bags in sizes from 1 to 50 kg capacity. This consists of transparent multi-layer with gas barrier between two layers of poly-ethylene of 0.078 mm thick.) polypropylene (PP bag) 300 gauge, low density polyethylene (LDPE) pouches 200

gauge, PP-HDPE Woven bag, Gunny bag each, heat sealed and placed in ambient room temperature conditions. The sample size was 3 kg. The composite sample was then used for determination of quality parameters at laboratory of Central institute of post-harvest engineering and technology, Ludhiana. The samples are being analysed for Microbial quality parameters initial and after an interval six month in ambient storage condition.

Microbial analysis

Microbial analysis was done to determine the microbial stability of green gram over time. A weight of 10 g of green gram was aseptically taken from each bag and homogenised in 90 mL of the sterilised physiological solution. Five-fold serial dilution was done and each dilution was plated out in triplicate on a plate count agar for aerobic mesophilic bacteria and potato dextrose agar for mould and yeast using pour plate method. Plates were allowed to cool and then incubated at 37°C for 48 h and 26°C for 72 h for bacteria and fungal and respectively (Akhtar *et al.*, 2008). Visible colonies were counted after incubation and the results were reported as log CFU/g. Sterile plates of both agars were open for 10 min around the work area and in the laboratory to ascertain the microbial state of the environmental.

The microbial analysis of fresh green gram kernels was mainly done for the overall bacterial and fungal count. The microbial analysis was done for five treatments each under ambient storage conditions those were found to be superior over other treatments for quality parameters.

Counting and reporting

On third day after incubation number of colonies developed on the plates was recorded. The colony forming units per gram

i.e. CFU/g was calculated for plates yielding bacterial and fungal colonies separately.

$$\text{Formula- CFU/g} = \frac{\text{Average number of colonies}}{\text{Dilution factor}}$$

Color analysis

The surface color of seeds was measured using Ultra Scan VIS Hunter Lab (Hunter Associates Laboratory Inc., Reston VA., USA). A glass cell containing seeds was placed against the light source, covered with a black cover and 'L', 'a', and 'b' color values were recorded. The L* is the lightness coefficient, ranging from 0 (black) to 100 (white) on a vertical axis. The a* is purple-red (positive a* value) and blue-green (negative a* value) on a horizontal axis. A second horizontal axis is b*, that represent yellow (positive b* value) or blue (negative b* value) colour (Plate 3.18). Digital colorimeter shows L-value, which denotes the degree of whiteness, was chosen to represent the colour value of sample (Anantheswaran *et al.*, 1986). Total color difference (ΔE) was calculated as:

$$\Delta E = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2}$$

Results and Discussion

Total bacterial count

Treatments were analyzed to workout total bacterial count in cfu/gm on Plain Count Agar media by completely randomized design (Gomez and Gomez, 1986). Data was subjected to analysis of variance using WASP-1 software (www.cssri.res.in). The analyzed data is summarized through Table 1 and 2.

Results indicate that in 10⁻¹ dilution treatment T₂ was significantly superior over other treatments with least bacterial count (2.26 x 10⁴). T₃ and T₄ were at par with T₂ followed by T₅ and T₁. In 10⁻² dilution T₂ was

significantly superior over other treatments with least bacterial count (1.24×10^5) followed by T₃ and T₄. In 10^{-3} dilution T₂ was significantly superior over other treatments with least bacterial count (8.60×10^5) followed by T₄. In 10^{-4} dilution T₂ was significantly superior over other treatments with least bacterial count (5.10×10^6) followed by T₄.

Similarly, in 10^{-5} dilution T₂ was significantly superior over other treatments with least bacterial count (1.40×10^7) followed by T₄. This indicates that treatment T₂ i.e. Packaging in 300 gauge poly propylene bag had least bacterial load followed by T₄ i.e. Packaging in white PP-HDPE woven bag. Thus, it is clear that 300 gauge poly propylene bag is better packaging material as far as spoilage due to bacteria is concerned that is followed by white PP-HDPE woven bag. At the same time, hermetic bags were having highest bacterial load

Total fungal count

Treatments were analyzed to workout total fungal count in cfu /gm on Potato Dextrose Agar media by completely randomized design (Gomez and Gomez, 1986). Data was subjected to analysis of variance using WASP-1 software (www.cssri.res.in). The analyzed data is summarized through Table 1 and 2.

Results indicate that in 10^{-1} dilution treatment T₄ was significantly superior over other treatments with least fungal count (0.00) followed by T₂, T₃ and T₁ those were at par. In 10^{-2} dilution T₄ and T₃ were significantly superior over other treatments with least fungal count (0.00) followed by T₂ and T₁. In 10^{-3} dilution T₄, T₃ and T₁ were significantly superior over other treatments with least fungal count (0.00) followed by T₂. This indicates that treatment T₄ i.e. Packaging in

white PP-HDPE woven bag, developed least fungal load followed by T₃ i.e. Packaging in 200 gauge poly propylene bags followed by T₁ i.e. Packaging in hermetic bags. Thus, it is clear that white PP-HDPE woven bags are better packaging material as far as spoilage due to fungi is concerned that is followed by 200 gauge poly propylene bags and then hermetic bags.

From the results of bacterial as well as fungal load it is apparent that white PP-HDPE woven bags had overall least microbial load. At the same time air tight packaging materials like polypropylene bags and hermetic bag had higher microbial load. Microbial load in gunny bags was significantly higher than all the other packaging materials under study.

This is because the environment inside the hermetic bags and polypropylene bags has high relative humidity with warm temperature that favors microbial growth. These results support the findings of Vales *et al.*, (2014) those have reported that in hermetic bags because of high relative humidity together with warm temperature favored the development of fungi and production of toxins when they studied the storage behavior of pigeon pea.

Gunny bags had even higher microbial load this may be ascribed to the accessibility of a dampness because of the permeable nature of the bag as compared to other packaging materials under study. These results confirm the findings of Ranjan *et al.*, (1992) those have reported the similar trend during storage of wheat. Suitability of white PP-HDPE woven bags for storage of green gram observed during current study contradicts the findings of Kayaa and Warren (2005) those have reported higher fungal load in stored wheat grain in polypropylene woven bags resulting into high aflatoxin levels.

Table.1 Effect of packaging material on total bacterial count at 10^{-1} to 10^{-5} dilution on PCA media

Treatment	Avg. Bacterial load (cfu/gm)				
	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}
T ₁	6.14 x 10 ⁵ (5.78)	6.14 x 10 ⁵ (5.78)	6.86 × 10 ⁶ (6.83)	6.53 × 10 ⁷ (7.81)	3.86 × 10 ⁸ (8.58)
T ₂	1.24 x 10 ⁵ (5.09)	1.24 x 10 ⁵ (5.09)	8.60 × 10 ⁵ (5.93)	5.13 × 10 ⁶ (6.71)	1.40 × 10 ⁷ (7.14)
T ₃	2.21 x 10 ⁵ (5.34)	2.21 x 10 ⁵ (5.34)	2.03 × 10 ⁶ (6.30)	1.54 × 10 ⁷ (7.18)	2.62 × 10 ⁸ (8.41)
T ₄	2.33 x 10 ⁵ (5.36)	2.33 x 10 ⁵ (5.36)	2.30 × 10 ⁶ (6.36)	2.86 × 10 ⁷ (7.45)	3.86 × 10 ⁷ (1.96)
T ₅	5.11 x 10 ⁵ (5.71)	5.11 x 10 ⁵ (5.71)	4.01 × 10 ⁶ (6.60)	3.26 × 10 ⁷ (7.51)	2.26 × 10 ⁸ (8.35)
Level of significance	0.05	0.05	0.05	0.05	0.05
SE	0.0391	0.0391	0.0591	0.0517	0.1173
CD	0.084	0.084	0.0604	0.111	0.252

Note: * indicates log_e transformation of data

Table.2 Effect of packaging material on total fungal count at 10^{-1} to 10^{-3} dilution on PDA media

Treatment	Avg. Fungal load (cfu/gm)		
	10^{-1}	10^{-2}	10^{-3}
T ₁	1.34 x 10 ² (2.12)	3.67 x 10 ³ (3.56)	0.00 (0.00)
T ₂	1.34 x 10 ² (2.12)	3.67 x 10 ³ (3.56)	3.60 x 10 ⁴ (4.55)
T ₃	1.00 x 10 ² (2.00)	0.00 (0.00)	0.00 (0.00)
T ₄	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
T ₅	4.67 x 10 ² (2.66)	3.33 x 10 ³ (3.52)	2.66 x 10 ⁴ (4.42)
Level of significance	0.05	0.05	0.05
SE	0.1197	0.1141	0.0931
CD	0.257	0.245	0.200

Note: * indicates log_e+1 transformation of data

Fig.1 Pictorial presentation of effect of colour variation during storage

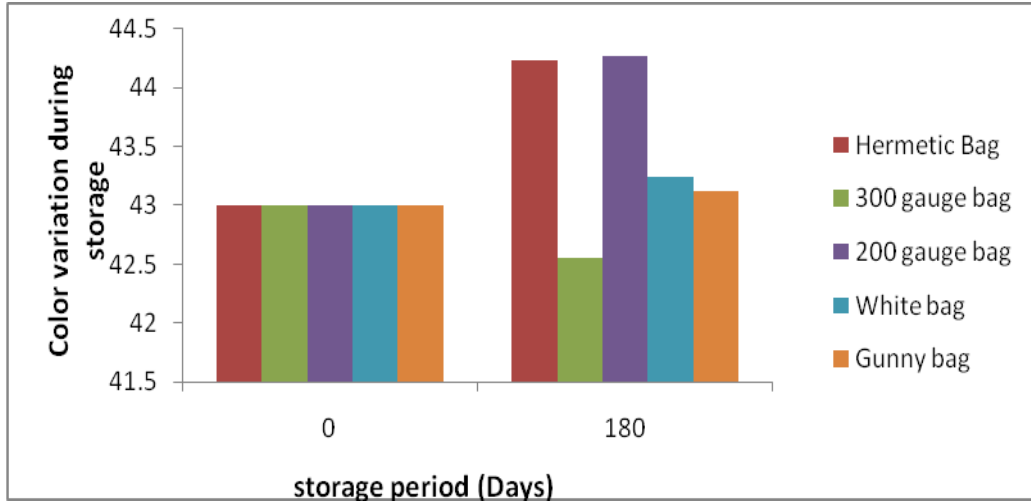


Plate.1 Serial dilution plate



Plate.2 Counting colonies

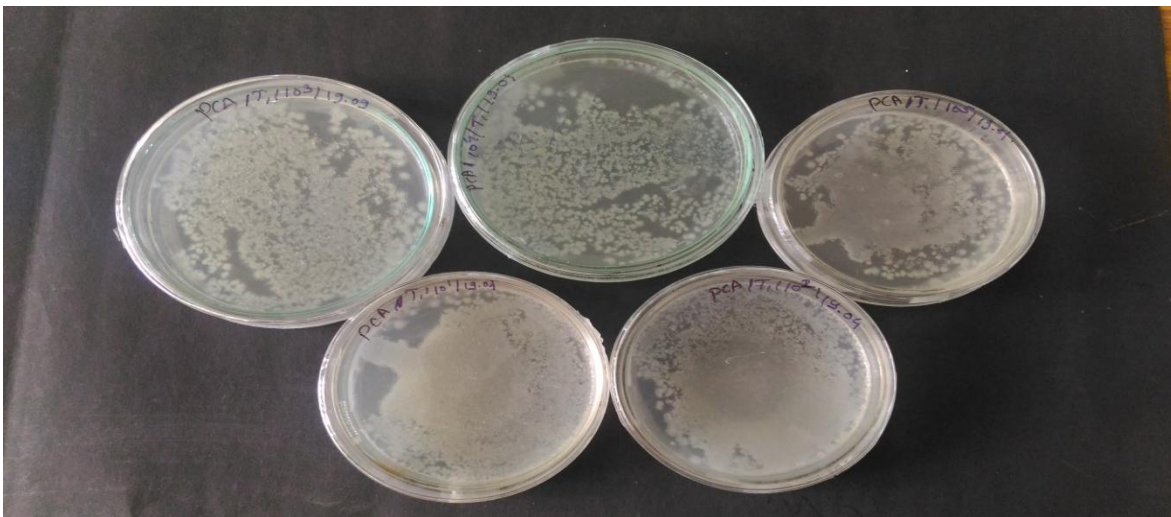
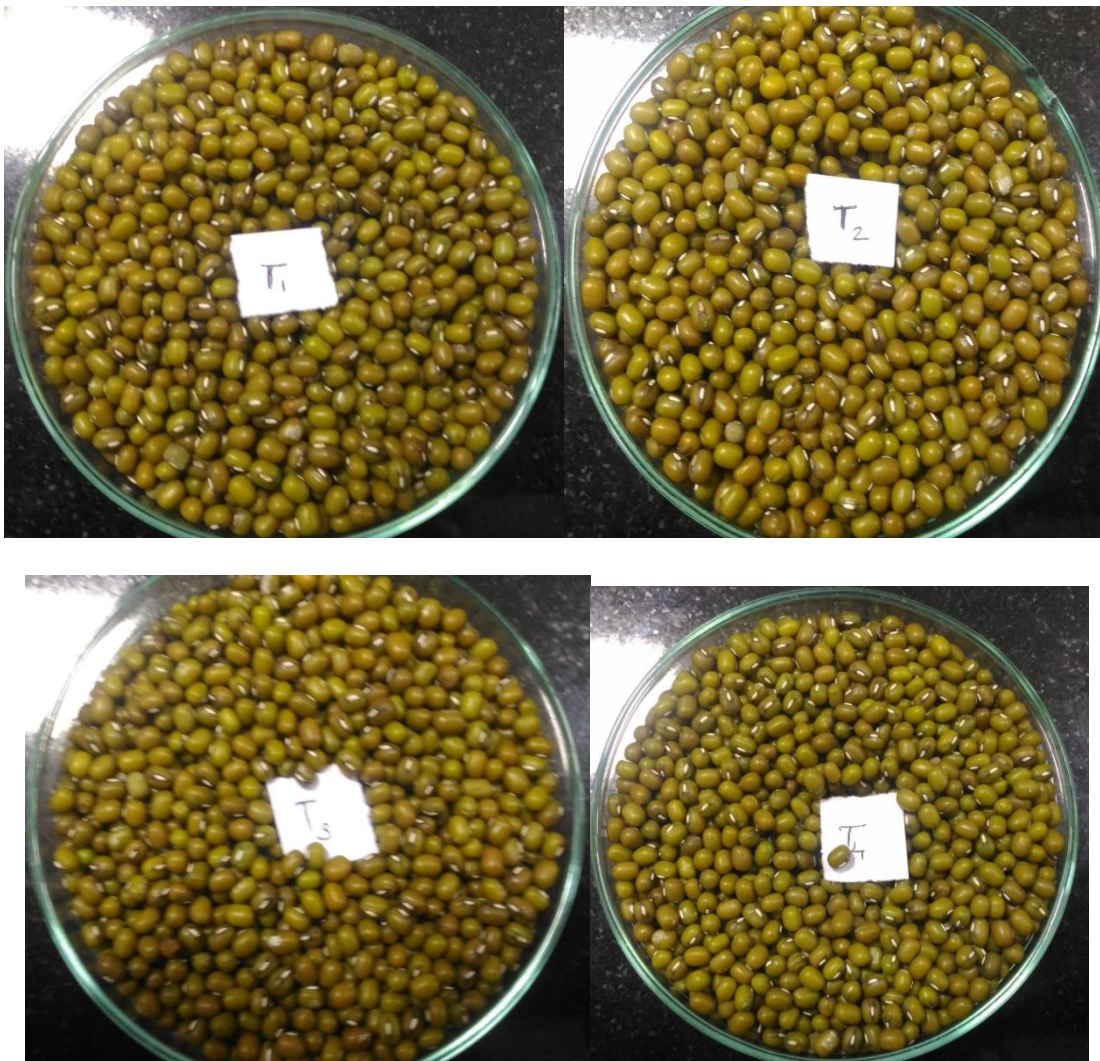


Plate.3 Ultra Scan VIS Hunter Lab



Plate.4 Color of after 6 month storage of green gram





Colour analysis

Colour is often used as an indication of quality of freshness for food product. Hence, it has become important for food processors to evaluate and grade their product based on colour. Colour values measured using a colour flex Hunter lab colourimeter, were relative to absolute values of perfect reflecting diffuser as measured. In the study the results found that the maximum delta E value 44.28 colour deviation in 200 PP bag and hermetic bag and minimum in delta E value 42.75 colour deviation in 300 PP bag (Fig. 1).

Hence it was significantly colour difference in different type of storage material. Colour changes increased across the storage, the degradation of colour during storage could be indicating loss of nutritional values due to the auto oxidation reaction of the anthocyanin and β -carotene (Kaur *et al.*, 2013).

It can be observed that there was increasing the in delta E value due to the air tight storage method or causes the respiration rate on the green gram stored in different packaging material. current study contradicts the findings of (Thirumdas *et al.*, 2016) was reported that this may be due to etching caused by the plasma species on surface

exposing the inner core to the surface.

The results of bacterial as well as fungal load it is apparent that white PP-HDPE woven bags had overall least microbial load.

Microbial load in gunny bags was significantly higher than all the other packaging materials under study.

The value of color ΔE was found max. in hermetic bag (44.3) and min. in 300 PP bag (42.1) as compared to fresh green gram.

The present study suggest that green gram pluses should be stored up to 6 months in hermetic bag without any fumigation and maintained the food quality

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