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PROXIMATE COMPOSITION OF SELECTED HERMETICALLY STORED COWPEA (Vigna unguiculata)

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ABSTRACT

Cowpea (*Vigna unguiculata*) is a food grain legume which serves as an important source of protein for many people in Nigeria and other developing nations. Cowpea storage helps to maintain all- year round supply, stabilize market price and minimize postharvest losses. This study investigated the effect of storage period on the proximate composition of two varieties (viz. brown and black-eyed cowpea) of cowpea seeds stored hermetically in plastic bins in a humid tropical environment. The cylindrical plastic bins used for storage were of dimensions 0.75 m height and 0.35 m diameter and they were filled up to 0.70 m height (capacity of 0.0674 m3). Proximate analysis was carried out on the samples before and after a storage period of 90 days. The outcome of study showed the colour of the two varieties of the cowpeas to remain the same after a period of 90 days storage. Also, no living insects were found after storage and which makes the hermetic storage of cowpea grains with polythene bag in plastic bin to be effective. The moisture content, protein, crude fibre, ash content, ether extract and dry matter of the brown-eyed cowpea before storage were established to be 5.91%, 24.15%, 3.3%, 3.1% and 4.5%; while that the black-eyed cowpea were 6.45%, 20.05%, 3.1%, 2.9% and 3.9% respectively. The proximate composition of the two varieties tend to increase after storage; the brown-eyed cowpea was found to have moisture content, protein, crude fibre, ash content, ether extract and dry matter of 12.85, 27.65, 7.8, 2.9, 6.95 and 87.15% while of black-eyed cowpea were 11.8, 23.28, 7.10, 2.25, 6.15 and 87.7% respectively. The brown-eyed cowpea grains have higher nutritional values compared to the black-eyed cowpea grains at the end of the storage. The weight of the cowpea grains reduced after a storage period of ninety days. This may be as a result of atmospheric conditions. It is therefore established that plastic bin could be adopted for hermetic storage of cowpea.

Keywords: Cowpea, Storage, Proximate Composition, Mass Loss, Storage Period

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp) which belongs to *Leguminosae* family is an indigenous crop in Africa, which is grown and also consumed having 23% - 25% protein content (Bawa et al., 2012). The cowpea grains contain about 23% protein and 57% carbohydrate, while the leaves contain between 27% and 34% proteins. The leaves and grains are also supplied as high protein feed and fodder to livestock (Pule–Merlenberg et al., 2010; Nwagboso et al., 2024). Cowpea grows well in the Guinea and Sudan Savannahs part of Nigeria. It was discovered that Nigeria is the largest producer of cowpea all over the world accounting for 46% of global production and 48% of Africa's production (Nwgboso et al., 2024). The greater percentage of these productions are being utilized for various food preparations such as bean pudding, bean cake, baked beans, fried beans, bean soup etc. while small quantities are being processed for industrial processes.

African nation such as Nigeria is the center for world-wide collection and testing of cowpea germplasm. In several components of West Africa including Nigeria, cowpeas seeds are consumed as boiled seeds alone or in combination with other foods such as rice, maize and plantain (Henshaw, 2000). Cowpeas are processed into paste for the preparation of assorted ancient foods, such as Akara (Fried cowpea paste and *moin - moin*, steamed cowpea paste). Cowpea seed is valued as an organic process supplement to cereals and an extender of animal proteins (Dan'aba et al., 2023; Henshaw, 2008). It contains high proportion of protein. Cowpea is also called Black-eyed pea, Brown-eyed pea, Southern pea, Labia, Niebe, Crowder pea, Frijole or Couple (Makanjuola et al., 2025).

Mijinyawa, (2002) classified postharvest losses of cowpea into qualitative, organic, seed viability and commercial losses which could be due to several factors like temperature, moisture content, relative humidity, oxygen and carbon dioxide. Storage of cowpea is a beneficial venture in Nigeria for the purpose of maintaining regular supply all over the year, price stabilization and minimizes postharvest losses. Government purchases excess cowpea at time of harvest at low prices and release them at regular intervals in times of scarcity to force prices down and prevent inflation. Despite these merits, cowpeas storage has always been restricted by pests and diseases which lead to their deterioration and losses of nutritive value. The most constraint to cowpea storage is infestation by pest such as insect. The types and colour storage media was also found to play a role in extent of infestation of cowpea by weevil (Sanon et al., 2010; Gbarage et al., 2024). Bawa et al., (2012) and Richard et al. (2023) reported that presence of fungal diseases growing on or in stored cowpea cause a variety of losses, such as decrease in germinability, heating and mustiness, change in taste and discoloration. Kirigia et al. (2018) reported the storage of cowpea leaves at room temperature at relative humidity of 50 to 55 % which led to a sharp reduction in phytonutrients after four days, but mostly remained stable in cold storage at a temperature of 5oC. Aremu et al. (2015) investigated effect of storage media such as fridge, freezer, airtight container using dry chilli pepper, phostosine on nutritional qualities of cowpea; the Cowpea seeds were stored in each medium for 4 months and at every 4 weeks interval, proximate analysis test was carried out on cowpea in each storage media to determine the level of their protein, fat and moisture content. More so, Falayi (2017) applied four household storage materials namely; jute bag, plastic container, polythene bag and hessian bag to determine the most appropriate material for the storage of cowpea.

There is therefore need for improvement of effective storage for cowpea which could be achieved by micro-environment control measures in storage structures; application of organic chemicals derived from plant materials. The storage of cowpea is crucial to avoid loss in order to enhance crop accessible throughout the year and seed preservation for planting (Adejumo and Raji, 2007). Storage of food grain is essential in order to ensure constant supply all year round. Good grain storage prevents grain losses and maintains grain quality. One of the most effective means of achieving this is the use of fumigation or controlled atmosphere storage. The techniques work by holding grain in a gas-tight enclosure in a gaseous atmosphere that will kill or limit agents of bio-deterioration (Dramani, 2010; Osei-Boahen, 2017). Storage conditions might influence the production, yield and the grain quality during planting. Safe storage will maintain cowpea quality and viability. Insects are by far the most contributing factor to effective storage of cowpea. The most common insect pest that affects cowpea during storage is weevil called *Callosobruchus maculatus*.

Cowpea storage life depends on moisture content before storage. Lower level of moisture content gives better quality of seeds in storage. Under humid storage conditions, the cowpea grain may deteriorate hastily, resulting in qualitative and quantitative losses. Qualitative losses include nutritional degradation, appearance changes, loss of germination capacity, presence of insect fragments and mold contamination. In tropical developing countries like Nigeria, a larger proportion of cowpea crop harvested is usually stored in humid and warm weather conditions which affect the quality of the cowpea with time. Most crops stored by subsistent farmers are inappropriately preserved; thus leading to speedy deterioration of the grains, primarily because to growth of molds. Conventional storage facilities are capital intensive and more so inaccessible to medium scale farmers. Medium scale storage facilities are recently adopted by subsistence farmers. It is therefore necessary to establish the impact of asphyxiation during storage of cowpea. This study investigated the effect of hermetic storage using plastic bins on proximate composition of two selected varieties of cowpea.

MATERIALS AND METHODS

Sample Preparation

Fresh and healthy cowpea seeds were purchased from Bodija market in Ibadan, Oyo State, Nigeria. Two varieties namely brown-eyed and black-eyed cowpeas were selected and cleaned manually, to ensure the seeds were free of dirt, broken or immature grains and other foreign materials as shown in Figure 1.

Measurement of Moisture Content in Storage Bin

The experiments were conducted under a well-ventilated shed at Department of Agricultural and Environmental Engineering, University of Ibadan, Nigeria. Two cylindrical plastic bins were used for the storage of the cowpeas. Each plastic storage bin has dimensions of 0.35 m diameter and 0.75 m height as shown in Figure 2. Moisture sensors consisting 4 m long cables having sensitive metal at one end and a probe on the other end were used. The metallic ends were placed at 0.155 m width spacing and 0.34 m height spacing of the wooden stick inside the plastic storage bin. The moisture sensors were configured at five chosen representative positions in the storage bin throughout the experimental period while the probes were connected to the signal processor for the record of moisture content within the storage bin. Placement of the moisture sensors in the bins was carried out before filling them with the cowpeas. The initial mass of the two varieties of cowpeas were determined using a digital weighing. The initial mass of 67kg was stored for the two varieties. Brown-eyed and black-eyed cowpeas were filled into bins A and B, respectively to 0.7 m height in each bin. The plastic storage bins were tightly closed and the cowpeas were stored for a period of three months.

Figure 1: Brown and black eye cowpea

Figure 2: Plastic bins loaded with brown-eye (A) and black-eye (B) cowpeas

Figure 3: Brown-eye (A) and black-eye (B) cowpea stored inside plastic bin with polythene

Evaluation of Proximate Analysis of Cowpea Samples

Proximate analysis was conducted on the samples of cowpeas taken from bin A and bin B at the beginning and end of the storage period which lasted for a period of three months as shown in Figure 4. This was conducted to determine the nutritional values of the brown-eyed and black-eye cowpeas stored in each container. Compositional parameters obtained in the proximate analysis of the cowpea samples were moisture content, crude protein, ether extract (fat), crude fibre, ash content and dry matter.

RESULTS AND DISCUSSION

Proximate Analysis of Cowpea Samples Storage

Table 1 showed the results of the proximate analysis of cowpea samples in bins A and B before and after storage. The result of the proximate analysis reveals that the blacked-eyed cowpea grains have higher moisture content compared to the brown-eyed cowpea grains while other parameters such as protein content, crude fiber, ash content, and ether extract for brown-eyed cowpea grains are higher in nutritional values compared to the parameters of blacked-eye cowpea grains before storage. The moisture content, protein, crude fibre and ether extract of brown eye cowpea increased from 5.91 to 12.85, 24.15 to 27.65, 3.3 to 7.8, 4.5 to 6.95 % respectively after storage while ash and dry matter reduced from 3.1 to 2.9, 94.09 to 87.15% after storage. Dominic et al. (2017) obtained similar values for moisture content of cowpea after storage.

Table 1: Proximate analysis of cowpeas before and after storage

Parameters	Brown-eyed		Blacked-eyed	
	Before	After	Before	After
Moisture Content (%)	5.91	12.85	6.45	11.80
Protein (%)	24.15	27.65	20.05	23.28
Crude fiber (%)	3.3	7.80	3.1	7.10
Ash (%)	3.1	2.90	2.9	2.25
Ether Extract (%)	4.5	6.95	3.9	6.15
Dry matter (%)	94.09	87.15	93.55	87.70

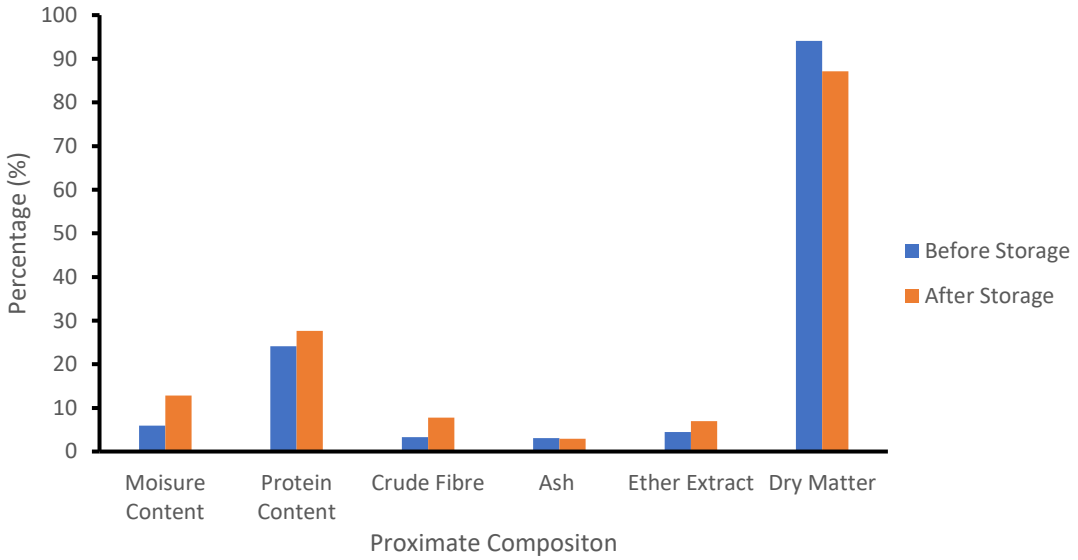

Figure 4: Proximate composition of brown-eyed cowpea before and after storage

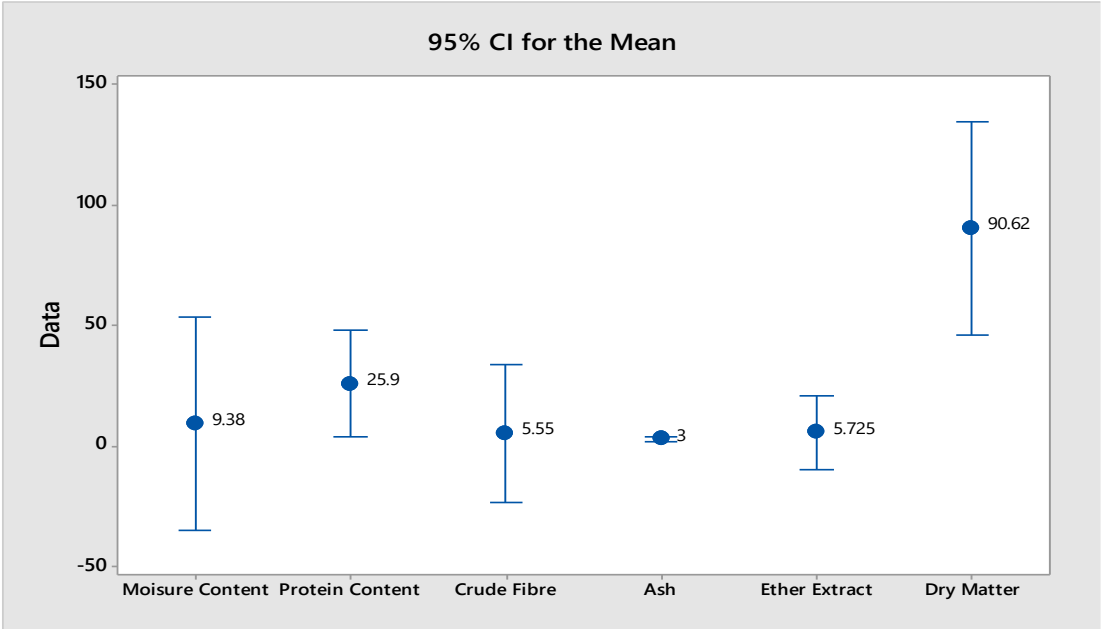

Figure 5: Interval plot for proximate composition of brown-eyed cowpea before and after storage

Also, the moisture content, protein, crude fibre and ether extract of black eye cowpea rose from 6.45 to 11.80, 20.05 to 23.28, 3.1 to 7.10, 3.9 to 6.15 % respectively after storage while ash and dry matter reduced from 2.9 to 2.25, 93.55 to 87.70% after storage. This could be as a result of period of year the cowpea was stored as observed by Zia (2006); thus, indicating the significance of storage condition of the grain as well as the immediate micro-environment of the grain. The deviation of these values from the median values as depicted in Figures 4 and 5 showed the impact of storage period on the brown eyed cowpea. Naveed et al. (2023) reported the influence of variation in environmental factors on nutritional and antioxidant properties of brown basmati rice during which corroborate with all the observations.

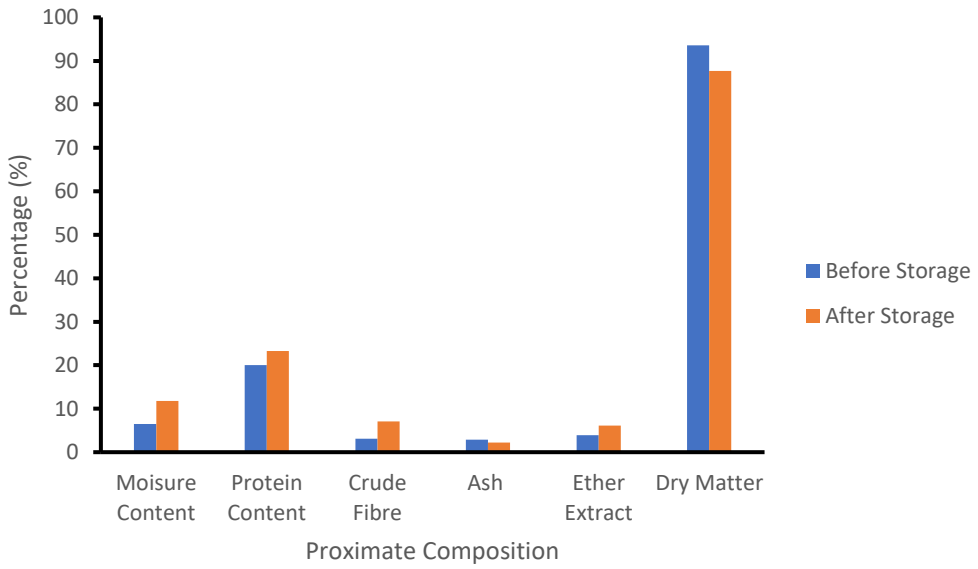

Figure 6: Proximate composition of black-eyed cowpea before and after storage

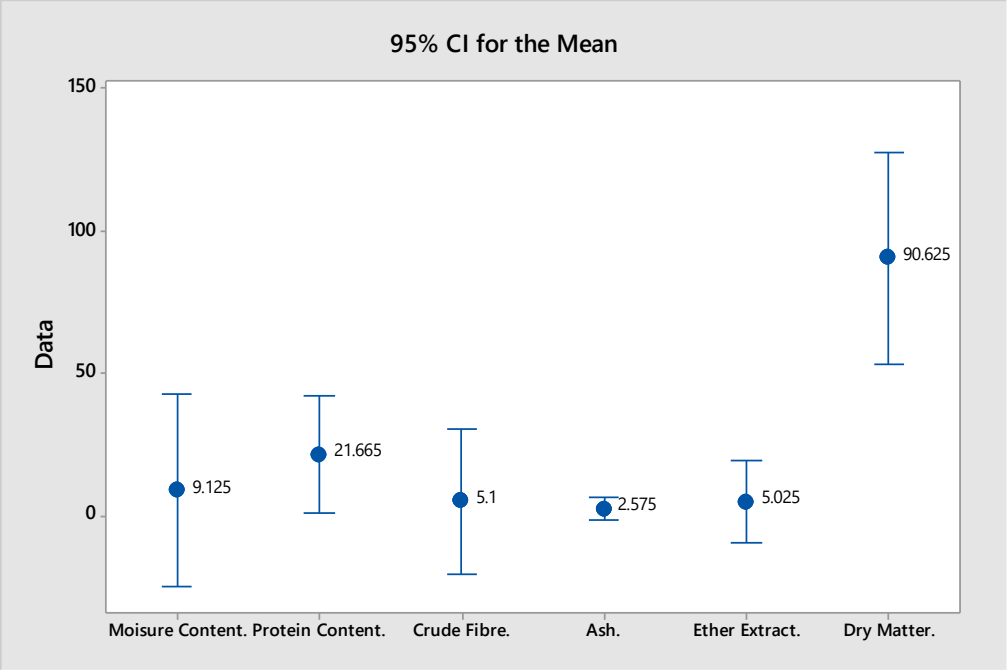

Figure 7: Interval plot for proximate composition of black-eyed cowpea before and after storage

It was observed that black-eyed cowpea has higher moisture content while brown-eyed cowpea shows higher protein, crude fibre, ash, and ether extract before storage which is consistent with the natural variability in nutrient composition among cowpea varieties. Similarly, Usman et. al. (2022) reported that different cowpea varieties exhibit distinct proximate profiles, which can influence their nutritional value and storage behaviour. However, the negligible difference in proximate values before and after storage suggests effective preservation of nutritional quality using hermetic storage media (Nda-Agyima, 2014). This is supported by research on cowpea seed storage under controlled conditions. For instance, Saleh, et al (2021) found that hermetic storage bags maintained seed moisture and protein content better than traditional woven bags, thereby preserving nutritional quality over time. Similarly, Osei-Asibey et al. (2022) reported that improved storage technologies like PICS (Purdue Improved Crop Storage) bags reduce mould growth and maintain seed quality which promote its suitability for cowpea storage without significant nutritional degradation.

CONCLUSION

The brown-eyed cowpea grain has higher nutritional values compared to the black-eyed cowpea grains at the end of the storage. The moisture content, protein, crude fibre and ether extract of brown eye cowpea was established to rise from 5.91 to 12.85, 24.15 to 27.65, 3.3 to 7.8, 4.5 to 6.95 % respectively after storage while ash and dry matter reduced from 3.1 to 2.9, 94.09 to 87.15% after storage. Also, the moisture content, protein, crude fibre and ether extract of black eye cowpea rose from 6.45 to 11.80, 20.05 to 23.28, 3.1 to 7.10, 3.9 to 6.15 % respectively after storage while ash and dry matter reduced

from 2.9 to 2.25, 93.55 to 87.70% after storage respectively. The differences in the nutritional content of both brown and black eye cowpeas before and after storage were negligible, which established the adoption of plastic bin as being suitable for hermetic storage of brown and black eye cowpeas.

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