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Influence of Biotic and Abiotic Factors on Biochemical Changes in Stored Groundnut

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ABSTRACT

Groundnut (Arachis hypogaea L.) is an important food legume in several developing and developed countries and an oil seed crop belongs to the family Leguminosae. In India, Telangana state is one of the major groundnut growing states. The production and safely storage of groundnut pods by traditional storage methods were not much effective due to sever multiplication of storage pest and fungi. In this paper, we demonstrate the efficacy of triple layer bags (that comprises of two inner high density polyethylene bags and one outer woven polypropylene bag), for protecting pods from quality deterioration due to influence of Caryedon serratus and Aspergillus flavus under 10 and 14% moisture conditions. Results indicate the total oil and protein content was decreased in traditional storage bags in comparison to triple layer bags.

Key words: *Groundnut, Aspergillus flavus, Caryedon serratus, Deteriorative changes.*

INTRODUCTION

Grain production of country depends on good quality seed. Quality seed play a very important role in production of a healthy crop. Post harvest management of stored product with less expenditure technique gain importance to maintain healthy seeds for further use.Post-harvest losses in groundnut range between 10 to 25% of the total production, of which 83% of damage was by bruchids alone, when stored for a period of 8-13 months under unprotected conditions[3]. Damaged pods by *Caryedon serratus* were more prone to attack of *Aspergillus flavus* where insects act as vectors to spread of fungus in stored groundnuts which ultimately leads to deterioration of during storage[10].

There are some reports on post-harvest deterioration of groundnut seeds by fungi[9]. The damaged kernels by bruchid results in reduction of oil content due to consumption of endospermic portion of kernels[7]. The depletion of protein content was observed under high moisture content in comparison to low moisture content[13]. Post harvest deterioration of groundnut due to improper storage and processing which leads to development of *Aspergillus flavus*[11]. The reduction of oil and protein content due to conversion of fats into free fatty acids and glycerol by *A. flavus* in stored groundnuts[12].Here an attempt has been made to ascertain the interaction effect of insect, fungi and moisture in different storage bags with reference to deterioration.

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MATERIALS AND METHODS

Ten kilograms of groundnut pods of cv. ICGV 02266 with moisture contents of 10% and 14% were weighed separately and placed in each of four treatment bags such as jute bags, polypropylene bags, triple layer plastic bags and jute bags treated with spinosad. Each of these bags was infested with 30 pairs of adult bruchids and spore suspension of *Aspergillus flavus* toxigenic strain @ 15 ml/bag. The bags were then moved gently upside and down for uniform mixing of *A. flavus* spore suspension and adult bruchids before closing the bags. The storage bags (one layer at a time starting with the inner most in the case of triple layer bags) were then tied manually by twisting the loose end of the bag around and folding it over then tying it tightly at the base of the twist and around the folded loop using a strong thread.

Each of the four bags used for the experiment were replicated thrice for given moisture percentage hence, a total of 24 such storage bags were formed as a batch. Three such batches were formed which were tested for bruchid damage and fungal infestation and subsequent aflatoxin accumulation after an interval of 2, 4 and 6 months of storage.

The fatty acid composition was estimated by using Near Infrared Reflectance Spectroscopy (NIRS; model XDSRCA, FOSS Analytical AB, Sweden, Denmark) which is a non-destructive method of estimating biochemical constituents.The oil and fatty acid composition of groundnut seeds at two different moisture regimes was estimated a day before setting up of the experiment by drawing a representative sample of pods which were shelled to obtain approximately 70-100 grams of kernels. The kernels so obtained were placed in a small rectangular cup of the NIRS equipment and allowed to scan. The scanned sample was then analysed by the equipment and data for total oil and protein compositions was displayed by the equipment on its monitor which was recorded.

RESULTS AND DISCUSSION:

The insects act as vectors in spreading the diseases or spores from one part to other parts. Insect contaminated with *A.flavus* in stored groundnuts was recorded maximum content of aflatoxin and ultimately leads to changes in oil and fatty acid composition of groundnut kernels which were unfit for human consumption.

The fungal population was increased during storage periods at high moisture levels in comparison to that of low moisture levels. The growth of *Aspergillus* is more in peanut samples due to better adaptation of these fungi to this substrate throughout storage, but *Aspergillus* growth was low at 10% moisture in comparison to 14-20% [4].

Changes in oil and protein content in different storage bags at different moisture levels at different sets of storage periods

There was a significant variation in per cent changes of the total oil content in different storage bags at different moisture levels. The maximum reduction in oil content was recorded in jute bag (50.60, 50.00 & 49.75 and 20.84, 18.95&18.70) at 14% moisture levels in comparison to 10 % moisture (51.53, 51.40 & 50.68 and 28.52, 21.23 & 20.70) after 2, 4 and 6 months of storage respectively. The minimal reduction of linoleic and oleic acid content was recorded in triple layer plastic bag at 14 and 10% moisture levels (Table1&2).

The individual effect of bag type, moisture and interaction of both reveal that maximum percent reduction in total oil and protein content was recorded in jute bag at 14% moisture level and minimum decrease was recorded in triple layer bag at 10% moisture levels.

Reduction in oil content, in jute bag, jute treated spinosad and polythene bags, was majorly due to heavy insect infestation, insect feeding and *A. flavus* fungal infestation. This is mainly because of favourable conditions inside these three types of bags such as free flow of oxygen from outside environment, relative humidity, temperatures and food source. This reduction of oil and protein content due to hydrolysis of lipids by invading fungi in stored kernels[8].Results also indicated that in triple layer plastic bag little changes occur in protein reduction at different moisture

levels at different storage periods due to increased carbon dioxide which was toxic to fungal development and insect multiplication but due to moisture some content fungal mycoflora was observed in triple layer plastic bag due to this little changes observed in reduction of protein content in triple layer bag stored kernels.Oil content reduction intern interrelated with saturated and unsaturated fatty acid content. Oil content was reduced more at 14% moisture in comparison to 10% due to high populations of insects and fungal growth. These results are supported by pervious investigations of Kashinath Bhattacharya and Subrata Raha[5].Changes in protein content was in triple layer plastic bag in comparison to all other treated conventional bags due to its structure ability reduce the fungal and insects development. These results are in close agreement with the results obtained by Upadhyay *et al*[14]. The Protein content was decreased in stored kernels due to fungus development via insect multiplication as fungus lipolytic activity by lipase enzyme leads to utilization of protein and sugar as substrate for their growth. These results are similar to the investigations conducted on nutritional changes in oilseeds in storage by Chavan[2].Fungal contamination causes a reduction in grain quality, through the utilization of stock protein and carbohydrates[6]. These results also similar with Braccini *et al*.[1], where reduction in protein, lipid and polyunsaturated fatty acids content due to *A. flavus*. These results are similar with Williams *et al*.[15], who reported that the multiplication of *A. flavus* was lower in triple layer bag with low moisture conditioned stored maize grain in comparison to high moisture maize grain which might be due reduce levels of oxygen levels with low water activity.

Table 1: Effect of storage bags and pod moisture content on per cent change in oil content at different storage periods

Per cent changes in oil content in different storage bags at different moisture levels				
		2 Months	4Months	6 Months
Per cent moisture	10	52.52a	52.40a	51.59a
	14	51.37b	50.85b	50.35b
S.E(m)		0.02	0.02	0.02
C.D(P= 0.01)		0.08	0.08	0.08
Bag type	Triple layer bag	53.12a	53.00a	52.20a
	Polythene bag	51.92b	51.60 b	50.82b
	Jute bag treated with Spinosad	51.68c	51.20c	50.75b
	Jute bag	51.06d	50.70 d	50.12c
S.E(m)		0.03	0.03	0.03
C.D(P= 0.01)		0.11	0.11	0.11
Interaction (Moisture x Bag type)				
10%	Triple layer bag	53.50a	53.40a	52.60a
	Polythene bag	52.70b	52.60b	51.60c
	Jute bag treated with Spinosad	52.36c	52.20c	51.50c
	Jute bag	51.53d	51.40d	50.68d
14%	Triple layer bag	52.75b	52.60b	51.80b
	Polythene bag	51.14e	50.60e	50.05e
	Jute bag treated with Spinosad	51.00e	50.20f	50.01e
	Jute bag	50.60f	50.00g	49.57f
S.E(m)		0.04	0.04	0.04
C.D(P= 0.01)		0.14	0.17	0.14

*Values followed by the same letter are not significantly different

Table 2: Effect of storage bags and pod moisture content on per cent change in protein content at different storage periods

Per cent changes in protein content in different storage bags at different moisture levels				
		2 Months	4Months	6 Months
Per cent moisture	10	29.05a	23.35 a	22.21 a
	14	24.99b	21.06 b	20.73 b
S.E(m)		0.02	0.08	0.04
C.D(P= 0.01)		0.09	0.34	0.17
Bag type	Triple layer bag	29.74a	24.40a	24.18a
	Polythene bag	28.15b	22.31b	21.69b
	Jute bag treated with Spinosad	25.52c	22.04b	20.32c
	Jute bag	24.68d	20.09c	19.70d
S.E(m)		0.03	0.11	0.05
C.D(P= 0.01)		0.13	0.48	0.24
Interaction (Moisture x Bag type)				
10%	Triple layer bag	30.07a	24.64a	24.46a
	Polythene bag	29.00c	23.92b	22.94c
	Jute bag treated with Spinosad	28.62d	23.63b	20.76d
	Jute bag	28.52d	21.23c	20.70d
14%	Triple layer bag	29.41b	24.18ab	23.90b
	Polythene bag	27.30e	20.70cd	20.45d
	Jute bag treated with Spinosad	22.43f	20.45d	19.88e
	Jute bag	20.84g	18.95e	18.70f
S.E(m)		0.04	0.16	0.08
C.D(P= 0.01)		0.2	0.68	0.34

*Values followed by the same letter are not significantly different

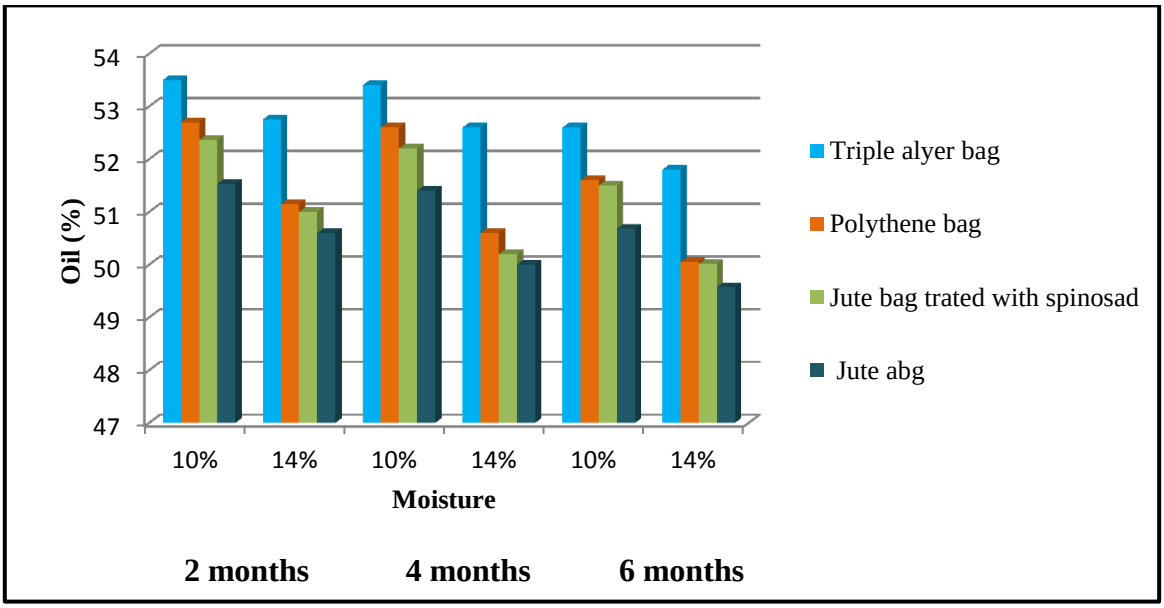

Fig. 1: Effect of bag type and moisture on oil content of groundnut kernels after 2, 4 and 6 months of storage

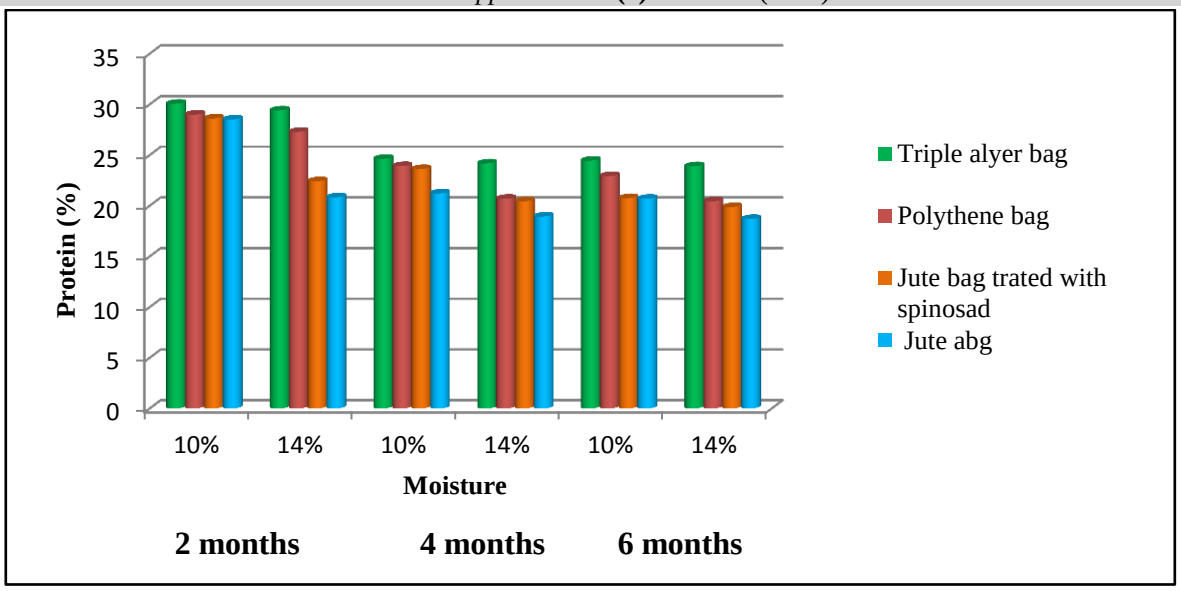

Fig. 2: Effect of bag type and moisture on protein content of groundnut kernels after 2, 4 and 6 months of storage

CONCLUSION

The study has demonstrated a high prevalence of the insects and fungi associated with groundnut kernels. Effective measures can be taken to protect the seeds from spoilage. Hence awareness should be created to farmers to store the produce in triple layer plastic bags at low moisture (10%) gave good level of protection against decrease in oil and protein content in comparison to traditional storage bags. There is an urgent need to increase awareness among farmers in aspects of the importance of hermetic storage technologies especially using triple layer plastic bags for storage of their product without loss of desirable qualities of stored product.

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