

STORAGE AND HANDLING TECHNIQUES OF MAIZE AND GROUNDNUT IN GHANA: A SURVEY REPORT

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ABSTRACT

A survey was carried out on the handling and storage of maize and groundnut by wholesalers at Ejura and Techiman markets in Ashanti Region and Brong Ahafo selected as markets close to production centers; Timber market and the Agboghloshie market in Greater Accra and Asawasi market in Ashanti as markets close to consumption centers. A total of 77 questionnaires were administered to the targeted clientele and samples of produce collected from each respondent. The data collected were analyzed using Statistical Package for Social Scientists (SPSS) and moisture of samples determined by a Hydromette Gann 86 moisture meter. Simple bar and pie charts were plotted and used in describing the responses collected. Analyzed data show that bagging was done mainly with jute, infestation was high at markets close to consumption centers, usage of storage structures are not popular among traders, and most of the samples collected had a moisture content above 14% and were observed to be infested with mold and pests.

Keywords: Moisture content, moulds, production centers, consumption centers.

INTRODUCTION

Handling of produce is the of moving of produce from one place to another in any given direction while storage is the act of keeping produce safely in order to minimize deterioration to the barest level. Adequate and effective storage of maize grains is therefore a major research thrust for enhanced maize productivity in order to reduce the huge economic loss (Olakojo and Akinlosotu, 2004). Handling and storage have been the work of the farmer, trader and governmental agencies, all involved in the marketing channel. Some form of attention has been given to the farmers through the help of extension officers. With the governmental agencies, they have their own experts who conduct research to communicate results on proper handling and storage of produce. However, in the case of traders, not much attention has been given to them. They go to farmers, purchase produce with a high moisture content i.e. above 13% making them suffer losses as a result of mould infestation as well as breakages in producing linked with how produce is handled.

There is global concern about food security; and governments all over the world have stepped up efforts towards producing food in large quantities as well as sealing all avenues of postharvest losses to offset the looming food crisis that the world is likely to face as its population expands. As government institutions are being equipped via the provision of modern warehousing and drying facilities, the private sector has not been encouraged to acquire these facilities. As a result, private marketing intermediaries do not have ready access to

improved drying and storage facilities (Armah *et al.*, 1989). Moreover, the intermediaries do not have access to any advisory service, which would help them to improve or acquire the skills required for their trade. Sequel, most traders do not want to involve themselves in the risk of storage. They buy in small quantities, quickly sell them and obtain a profit on each transaction in order to avoid the extra cost and therefore overlook the idea of using insecticides and building storage structures. Thus making produce more vulnerable to pest attack and other forms of deterioration.

As traders purchase produce from production centers (areas distant from the market), produce is subjected to different treatments. Offloading from vehicles can cause considerable damage depending on whether it is thrown or placed gently into the vehicles. The arrangement pattern adopted by the trader also to a great extent account for a lot of damage - when bags of maize are placed on bags of groundnut, it might lead to the breaking of the pods and also crushing of nuts. The nature of the bags used may significantly affect the storability of produce - a porous bag would allow the free flow of air to remove moisture produced during respiration, thus preventing the creation of micro-environment for mould production. The types of management practices adopted by traders cannot be underestimated in assessing the losses to be incurred. If pesticides are not used and leaky roofs are not patched, some sort of losses will occur.

Maize and groundnut were chosen for this study because of the fragility of the maize grain kernel, seed coat or germ-cells and the groundnut pods. Maize is a staple crop widely grown throughout the country and is the most

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important source of carbohydrate in most Ghanaian meals. Groundnut is known to be a rich source of protein (around 26% protein) (Nutritional Features of Groundnut, 2011). Since the protein needs of the people in the country have not been met, it only becomes necessary to carry out this study to help reduce losses that occur during handling and storage of groundnut, so that it can be substituted as a protein source for the unavailable animal protein in the diet of the citizenry.

Farmers sell the produce to wholesalers who transport it to markets close to the production centers. Most of the produce have high moisture content. Since wholesalers are close to the production centers, they can easily sell to buyers who transport it to other markets close to consumption centers. They do not construct appropriate structures for the produce, hence exposing them to the vagaries of the weather as well as the physical forces in transport – manner of packing, loading and offloading produce. Thus, before the produce gets to the ultimate consumer, a considerable amount of quantifiable postharvest losses might have occurred. The occurrence of these postharvest losses will reduce the sellers' profits but more importantly may threaten the food security of the country and the world at large if left unsalvaged. According to Boutrif (1998) in many developing countries, the combination of insufficient drying and humid atmospheric condition results in unacceptable levels of aflatoxin in harvested maize, groundnuts, tree nuts and other foods. Studies carried out in Africa have reported aflatoxin levels in staples such as maize and peanuts, which exceed the limits allowed by the Codex Alimentarius Commission (AFRO Food Safety Newsletter, 2006). Widespread aflatoxin contamination of locally grown maize is reported by Morbidity and Mortality Weekly Report (2004) to have occurred during storage of the maize under damp conditions.

Apart from the health threats to the public, Agriculture Food and Nutrition for Africa (1997) reported that the problems caused by mycotoxins have trade and economic implications. Mycotoxins pose a serious health risk to both humans and animals (Vedman, 2004). In domestic markets economic losses occur at various levels, from the commodity producers to the brokers, the processors and the animal producers. According to Bhat and Miller (1991), although there are many species of toxigenic moulds, only few mycotoxins affect cereals and groundnuts.

The present study seeks to achieve the following objectives: identify the management practices adopted by traders, and the materials and methods use in the handling and storage of maize and groundnuts; ascertain the effects of pest attack and moisture on the storability of maize and groundnut, and thus recommend ways of handling and

storing maize and groundnut to reduce postharvest losses in the marketing chain.

MATERIALS AND METHODS

The survey was conducted at Techiman Market (located Latitude 7.58⁰N, Longitude -1.93⁰E) in Brong Ahafo Region; Ejura Market (located Latitude 6.75⁰N, Longitude -1.52⁰E), and Asawasi market (located Latitude 6.70⁰N, Longitude -1.61⁰E) in Ashanti Region; Agboghloshie Market (located Latitude 5.56⁰N, Longitude -0.19⁰E) and Timber Market (located Latitude 5.56⁰N, Longitude -0.20⁰E) in Greater Accra Region as per the Google Map Centre of the Republic of Ghana.

Two markets were selected based on their proximity to the production centers. They include Techiman and Ejura markets while the others, such as Asawasi, Agboghloshie and Timber markets are located close to consumption centers. It is believed that traders visit Techiman and Ejura markets, purchase produce and then go back to distribute them at markets distant from the production centers, thus some of the produce could end up in the selected markets distant from the production centers. This helped in the assessment of the deterioration that emanated from handling and storage of the produce as it is moved from markets close to production centers to those at the consumption centers.

A questionnaire was prepared and copies conducted around these markets and responded to by the targeted clientele (wholesalers of maize and groundnut). Also, the mode of packing, loading, offloading, and structures used in the storage of produce were observed, comments recorded and deductions made from the observations.

A sampling probe was used in sampling produce in bags. Bagged produce were sampled at the bottom, middle and at the top parts or upper portion of the bags. Sampled produce collected from each respondent was brought to the laboratory for moisture content determination and observation of damage caused by insects and mould.

Moisture Content Determination

The moisture content of two samples of groundnut was determined using the vacuum oven method. 5g of each of the samples was ground and their moisture content determined. The samples were heated in an oven at a temperature of 130 ± 2°C for 2 hours to vapourize the moisture. The dried samples were reweighed and the differences caused by drying weighed as the weight of water contained in each sample (mass of water). The moisture content on wet basis was then determined by dividing the mass of water evaporated by the initial weights of the sample (mass of wet produce) and this reading was used in setting the Hydromette Gann 86 moisture meter to enable the moisture content of the

groundnut samples to be determined. The moisture content of the maize samples was determined directly by the Hydromette Gann 86 moisture meter.

Observation for Breakages, Pest and Mould Infestation in Samples

The collected samples were scrupulously examined for signs of physical damage, pest and mould infestation and notes taken.

RESULTS

Handling of Produce by Traders

Seventy-seven questionnaires were administered to the targeted clientele at the selected markets and their responses on the number of bags of produce they bring to store were collected. It revealed that 3% of the traders interviewed stored less than 10 bags, 9% stored between 11 and 20 bags, 36.40% stored between 21 and 30 bags and 52% of the traders stored more than 30 bags and those who fall within the majority group were traders found at markets close to production centers. These traders handle larger numbers bags of produce because they are bought quickly, at least within a week (and as such do not face any problem of pest attack that can reduce their profit margin). However, at markets close to consumption centers, the demand for the product is not as high as compared to markets close to production centers. Most traders there responded they store their produce for a longer time (a month or more). Traders at these centers therefore are faced with problems of pest and mold infestation.

Means to Transporting Produce

Analysis of responses on the means of transport used by traders revealed that 1% of traders use cars to convey their produce to the market; 92% use trucks; 7% use other means such as tractors, human labour, wheel barrows etc.

Arrangement of Produce in Vehicle

13% of the traders interviewed pack bags of maize on bags of groundnuts, 16% pack groundnut on maize and 71% mixed the produce together or do not adopt any arrangement pattern.

Loading and Off-loading of Produce from Vehicles

For responses on loading of produce into vehicles, 97% responded that the bags of produce are thrown into vehicles while 3% responded that the bags of produce are placed gently in vehicles. As regards off-loading of produce, 94% responded bags of produce are thrown down from the vehicles onto the floor while 7% responded bag of produce are held down gently.

Bagging Materials

The responses on materials used in bagging production indicate that 82% of the traders use jute sacs in bagging

their produce, 7% use plastics sacs and 12% use both plastics and jute sacs.

Pest attack on stored Produce

The responses given by traders on pest attack show that 73% of respondents claimed they have no problem with pest attack; 27% responded they are faced with pest attack. However, most traders in markets close to consumption centers responded their produce were attacked by pests due the fact that they produce remained in a store for a longer period before it was purchased.

Mould Infestation

Responses of traders on mould infestation indicate that 1% of the traders have problems with mould infestation while 99% responded in the contrary.

Management Practices

Sixteen percent of the traders stated that they adopted some form of management practice to control pest. The management practices adopted by these traders are given in figure 1, 8% spray produce with actellic; 1% trap pest such as mice; 7% use "magic" insecticides powder to control insects. However, 84% of traders do not adopt any practices.

Pest Encountered by Traders

With regards to responses to pest encountered by traders, 23% encountered weevils, 1% encountered mice and 4% encountered moths as shown in figure 2.

Moisture Content of Stored Produce

55% of the traders store their produce above moisture content of 13%; 40% store between moisture content range of 11.6-13%; and 5% store produce between a moisture content range of 9 - 11.5%.

Storage Structures

Responses on storage structures show that 22% have storage structures and 78% had no storage structures.

DISCUSSION

Handling of Produce by Traders

Since most of these traders do not want to incur extra cost to control pest and mould infestation, they handle a smaller number of bags of produce in order to sell them very fast to avoid such damages which will decrease their profit margins. Some traders close to the consumption centers responded that when a pest attack becomes more devastating, they sell the bags of produce to those who sell corn dough on credit in order not to lose eventually everything.

Means to Transporting Produce

92% of the traders use trucks in transporting their produce into store. Traders who store larger quantities and can

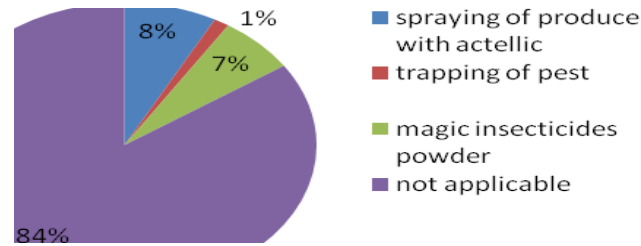


Fig. 1. Management practices adopted by traders.

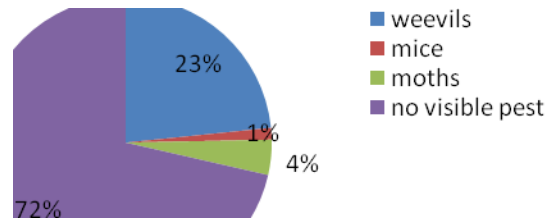


Fig. 2. Responses on pest encountered by traders.

afford hiring a truck to transport their produce to the market do so, but those who deal with a smaller number of bags form a group and contribute to hire trucks for their product to be brought to the markets. The group formed comprises a number of traders each contributing according to the number of bags of produce he or she wants to move to the market. This often leads to overloading of trucks, as most of them require that the trucks move all their produce at once. Others also use other means apart from trucks as at Ejura market, where most traders purchase the produce from farmers close to the marketing centers or in their neighbourhood and therefore use tractors, wheel barrows and in extreme case employ manual labour.

Arrangement of Produce in Vehicle

The study reveals that 71% of the traders do not know that the way produce are packed in the vehicle affects the storability of their produces as damage could be caused due to the weight one produce may exert on the other – bags of maize packed on bags of groundnuts, leads to the crushing of nuts and breaking of pods, and their subsequent rapid deterioration.

Though study shows that more traders pack bags of groundnuts on bags of maize in vehicles other than the reverse, a close analysis of the information given by traders indicates that they have their produce mixed up in the vehicles. This is because, majority of the traders comes together to form groups and hire trucks to transport their produce. In arranging the produce into the vehicles, care is taken to pack all the produce of one trader into the

vehicle before the others as this makes it easier for identification and off-loading of produce by drivers at the marketing centers. This way of packing presupposes that, if the first trader has bags of groundnut and maize, though he or she may pack bags of groundnut on the bags of maize, bags of maize are eventually packed on the bags of groundnut of the first trader by the next trader, and this may result in crushing of nuts and breakage of pods in the first trader's produce. In order to minimize losses in productivity due to the arrangements adopted by the traders, traders of similar commodities need come together and hire a truck to transport their produce to market.

Loading and Off-loading of Produce from Vehicles

The reasons assigned by most traders to the throwing down of bags of produce on the ground and throwing of bags of produce into vehicles as in the case of off-loading and loading respectively are that most drivers of the vehicles are often in a hurry to load and off load produce quickly in order to enable them go several rounds to increase their profit margins.

It is advisable that drivers carry wooden planes along with them in order to incline it from the ground level to the entrance of their trucks for the produce to be rolled down easily and gently so as to reduce breakages in produce.

Bagging Materials

82% of the traders use jute bag and this is due to fact that jute bags are cheaper than plastics sacs and more so can easily be sewn when torn as compared to plastics sacs

which cannot be sewn easily. It was observed that traders mainly use two sizes of bags at the market: mini bags and maxi bags. However, analysis of the responses given and observation made during the conduction of the survey show that more pests were encountered by those who employ the use of jute sacs in bagging their produce. Though the materials - jute and plastics sacs are all porous, the jute bags are more porous and as such allow more living organisms to enter into them than plastics sacs. These living organisms respire, producing heat and moisture, which raises the moisture content of the produce in the bags, thus creating a favorable micro-environment for other pest to attack the produce.

Pest attack on stored Produce

Most of those who claimed they have no problem with pest attack were located within markets close to the production centers except Asawasi market in the Ashanti Region which is close to consumption centers. Traders claimed they have no problems with pest because their produce are kept in store for a short time (that is within a week).

Mould Infestation

A close observation of the samples collected from each trader indicates that most of the traders' produce were infested with moulds. This suggests that the majority of the traders could not identify mould let alone know the causes of mould infestation. Traders must be educated on the causes of mould infestation and its effects and also, how to prevent it by extension officers.

Management Practices

Majority of the traders at the markets close to production centers do not adopt any management practices because they do not store produce for long before they are purchased whereas some of the traders found at market close to consumption centers responded they adopt management practices because they keep producing for a long time, i.e. a month or more. Observation during the interview with the traders, indicates most traders do not adopt any management practices to control pest like weevils because they claimed weevils are special 'friends' of maize and no matter the control technique adopted, they will persist, therefore they do not bother themselves to control them.

Traders must be made aware through education by extension officers that the damages that can be caused by pest are very significant especially when these pests are not controlled and their numbers allowed to exceed their economic threshold. Traders must also be taught pesticides management techniques such as the type of pesticides to use, the amount of pesticides to use and more importantly the concentrations which will not cause health hazards to humans but effectively control the pests.

Pest Encountered by Traders

Observations made at Ejura market shows that the mouse population is very high and this is because they store their tubers of yams by covering them with dried grasses in the open space near where they store their maize and groundnuts. Thus these dried grasses serve as hiding places for mice which attack their produce. Since the produce are not kept for a longer time, they claim the mice are a nuisance rather than a pest. Traders at Ejura market should treat the dried leaves used in covering the tubers of yam with rodenticides in order to control the mice population as the dried leaves serve as their hiding places.

Moisture Content of Stored Produce

Majority of the traders store their produce above the moisture content of 14% and this makes the produce vulnerable to pest and mould attack. Analysis of the responses given by the traders and moisture content determined for the samples collected indicate that most of those who encounter pest attack store their produce above 13%. This confirms the work done by Weinberg *et al.* (2008), which shows that grains of moisture content above 14% provides favourable conditions for grains to be attacked by pest and moulds. Traders must be encouraged to pack their produce on pallets and to seal all leakages on the roofs of their storage structures to prevent raindrops from trickling down into the stored produce. Worn out or torn tarpaulins should also be replaced by traders. Vents should be provided on their storage structures to allow free flow of air through the storage structures for heat built up in produce to be reduced. This will ensure low temperature to prevent excessive respiration which will generate moisture in stored produce, thus raising the moisture content of the stored produce.

Storage Structures

Most of those who do not have storage structures are those traders close to production centers and those who are at Asawasi market which is a market close to consumption centers. The reason being that, they do not store produce for a longer time, usually a week, and therefore finds it redundant building storage structures. These traders store the bags of produce packed on pallets in the open space and then cover these bags with polythene which are often torn, allowing rain drops to seep through them into the stored produce raising their moisture content and then making them vulnerable to pest attack and mould infestation.

Observation during the survey shows that some traders do not even pack the produce on pallets but rather on the bare floor. Most traders close to the consumption centers do not have proper designed structures. They store the produce under sheds constructed halfway with blocks and the top half left open, allowing the wind to blow raindrops onto the stored produce. Most of the traders who have

storage structures had no windows in them and those who even have windows keep them mostly closed as the cobwebs were seen totally covering them up. Thus the heat built in the produce due to respiration activities of the produce does not escape easily and this increases the deterioration rate of the stored produce. Traders who construct their storage structures halfway with blocks must be encouraged to cover the topmost with polythene sheets if they cannot afford the cost of using blocks or wood throughout, as this will keep raindrops blown into the storage structures by the wind out.

The survey carried out indicates that most of the traders use trucks in moving their produce to the market. Results show that majority of traders pack bags of groundnut on bags of maize when transporting these produce together, but close observation shows otherwise. Most traders throw produce in and out of vehicles when loading and off-loading into vehicles respectively. Majority of the traders patronize the usage of jute bags to bag their produce. Traders interviewed at markets close to the production centers responded they have no problem with pest and mould infestation because they do not store produce for a long time, whereas those close to consumption centers have problem with pest attack because they kept produce for a longer period before selling. Most traders interviewed indicated that they have no problem with mould development, but a close observation of samples collected revealed that the majority of them had their produce infested with moulds suggesting that most traders could not identify moulds let alone know how it grows. Observations revealed that majority of traders close to consumption centers do not have proper storage structures – produce is stored under sheds constructed halfway with blocks and the top most half left open allowing wind to blow raindrops onto the produce.

The study recommends that for proper maize and groundnut handling and storage, a wooden plane should be constructed for truck drivers to carry along with them, so that it could be inclined from the ground to the entrance of the trucks to allow produce to be rolled down easily from trucks, as this would reduce breakages in produce. It is also necessary traders who construct storage structures halfway with blocks are encouraged to cover the topmost half with polythene sheets if they cannot afford the cost of using blocks throughout, as this will ensure that raindrops are not blown onto produce by wind. Further studies should be carried out on the handling and storage of produce in the selected markets to ascertain quantitatively the losses that are incurred as well as to identify the best bagging materials to reduce pests attack.

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