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Full Length Research Paper

Optimizing Seed Extraction Processes to Mitigate Losses and Improve Quality in Egusi Melon (*Colocynthis citrullus L.*)

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This study determines the effect of methods of seed extraction on seed loss and viability on Egusi melon (*Colocynthis citrullus* L). Three methods of fruit breaking; vertical cut with knife, horizontal cut with knife and hitting with wooden club were tested to determine their effect on seed damage. Three covering materials; grass straw, black polyethylene sheet and no cover were also tested to determine their effect on the number of days to fruit fermentation and seed germination. The result showed that percentage seed loss resulting from vertical cutting with knife was 16% and was significantly higher than 3.4% seed loss arising from horizontal cut with knife and 0% from hitting with wooden club. It was also discovered that fruits covered with grass straw took 8.67 days to complete fruit fermentation while under black polyethylene cover it occurred at 12 days. Fruits that were left uncovered fermented at 9.33 days. Seed germination was also significantly affected by covering materials. Seed germination of 85.3, 80.0 and 30.0 were recorded on seeds obtained from fruits that were fermented with no cover, grass straw and black polyethylene cover respectively.

Key words: Seed extraction, germination, seed loss.

INTRODUCTION

The Egusi melon *Colocynthis citrullus* L. is a member of the cucurbitaceae plant family (Jeffrey, 1980). It is a tropical crop grown for its seeds. It is a native of Africa and is very popular in most African country especially Nigeria. The seed is rich in oil and protein, containing high levels of most essential amino acids (Nwokolo and Sim, 1987; Ogbonna, 2007). The egusi seed after peeling is ground and used in preparing soup and stew. The seed is also roasted and eaten as snack. Fermented egusi seed also served as protein rich condiment for preparing soup. The oil when extracted is edible and is used in frying. Girgis and Said (1968), reported that the oil contains high percentage of unsaturated fatty acid and is recommended for diet intended to reduce high blood cholesterol.

It has been reported that Egusi melon requires less effort and input to produce and yields as high as 900 kg/ha has be recorded (Ogbonna, 2007). The crop is therefore a cheap source of protein and oil in human diet.

However processing of Egusi fruit to extract the seeds is very tedious and requires plenty water. The fruit is first, made to ferment to make the extraction of the seed easy. To quicken fermentation the fruits are split open and later covered, some times, with grass straw in the field. Techniques adopted in splitting the fruits vary. Seed damages are bound to occur during the breaking process. However the degree of damage differs with the methods. Seed loss during processing is a phenomenal issue in crop production. Losses in both quantitative and qualitative attributes of seeds have been reported (Desai, 2004; Sinh et al., 2002,). Against this background the objectives of this study are to determine differences in seed loss associated with different methods of breaking Egusi melon fruit and the effect of different covering materials on rate of fruit fermentation and seed germination in Egusi melon.

MATERIALS AND METHODS

This study was conducted at the Department of Crop Science Research farm, University of Nigeria, Nsukka in 2009. The area is

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located on latitude 06°52' North and longitude 07°24' East and an altitude of 447 m above sea level.

Seeds of Nsukka Local cultivar of egusi melon obtained from the Department of Crop Science seed collection were used.

An area of land measuring 26.5 by 14 m was ploughed and harrowed and later prepared into seed beds. The seeds were sown in April 14, 2009 at the spacing of one by one metre. NPK 20:10:10 fertilizer at the rate of 200 kg/ha was applied to the crops at 4 weeks after planting. The plot was also clean weeded. At maturity, fruits were harvested from fifty plants selected at random. These were counted, weighed and recorded. The number of fruits/plant and weight fruits/plant were estimated by dividing by the number of plants (50).

Determination of proportion of seed losses due to methods of fruit breaking

The experiment was laid out in a complete randomized design (CRD) with six replications. The treatments include three fruit breaking methods; vertical cut with knife (VCK), horizontal cut with knife (HCK) and breaking by hitting with wooden club (HC). Eighteen hips of equal sized fruits were arranged according to the treatment design in a cleared area in the field. Each hip was made up of twenty fruits. Each treatment was replicated six times, meaning that each treatment was applied to six of the eighteen hips. This was done at random. Number of damaged seeds/fruit was obtained by counting the number of damaged seeds after fruit breaking in each hip. This was divided by twenty (20) which is the number of fruits/hip. Number of undamaged seeds/hip was also obtained by counting the seeds after processing. Number of undamaged seeds/ fruit was estimated by dividing number of undamaged seeds/hip by twenty. Total number of seeds/fruit was estimated by adding number of damaged seeds/fruit and number of undamaged seeds/fruit. Percentage seed loss was estimated from the above values.

Determination of effect covering materials on days to fruit fermentation and seed germination

The experiment was laid out in a completely randomized design (CRD) with six replications. The treatments comprised of three covering materials; grass straw (GC), black polyethylene sheet (PC) and no cover (NC). Eighteen hips of equal sized fruits were arranged according to the experimental design in a cleared area of the field. The fruits were cut horizontally into two halves with knife. Six hips were separately covered with grass straws. Another six hips were covered separately with black polyethylene sheets while the remaining six hips were not covered. The hips were inspected on daily basis. Number of days taken to complete fermentation was recorded for each hip.

After fermentation the seeds were extracted per hip and washed separately with copious quantity of water. The seeds were dried under the sun and later stored in black polyethylene bags. Ten seeds were taken from each of the eighteen seed samples for germination test. Eighteen plastic Petri-dishes were washed thoroughly and two layers of filter papers were placed in each of them. About 10ml of distilled water was poured on the filter paper. Each ten seeds sample was placed in a Petri-dish. Thereafter the Petri-dishes were placed on the laboratory bench. Percentage seed germination was obtained by daily count of the number of germinated seeds/Petri-dish up to ten days after plating the seeds.

This was divided by ten (total number of seeds in a Petri-dish) and multiplied by 100.

Data analysis

Data collected were subjected to analysis of variance according to the procedure described by Steel and Torrie (1980). Zero values were transformed using the square root transformation method. Detection of differences between means was done using the F-LSD method by Obi (2007).

RESULTS

Records obtained from the fifty sample plants showed mean number of fruits/plant of 2.5. After processing, mean number of seeds/fruit of 168 and weight of seeds/fruit of 21.08 g were also recorded. Estimated seed yield per ha was 568 kg.

The result of the effect of fruit breaking methods on number of damaged seeds/fruit revealed significant difference ($p < 0.05$) between the methods. Highest number of damaged seeds/fruit was observed in vertical cutting with knife. This was significantly higher than number of damaged seed resulting from horizontal cutting with knife and hitting with wooden club. No seed was damaged when breaking was done with wooden club (Table 1). Weight of damaged seeds/fruit maintained the same trend (Table 2). Number and weight of damaged seeds/plant and percentage seed loss followed the same pattern (Tables 3, 4 and 5). The observation made on the effect of covering materials on days to fermentation revealed that covering the hips with grass straws after fruit breaking resulted to early fermentation. This was followed by leaving the hips bare (no cover). Covering with black polyethylene sheet significantly ($p < 0.05$) delayed fermentation when compared with other covering materials (Table 6). Covering material also significantly ($p < 0.05$) affected seed germination (Table 7). Highest percentage seed germination was obtained from seed processed from fruits fermented without covering. No covering, however, had statistically the same effect on seed germination with covering with grass straws. Seeds from black polyethylene covered hips gave the least seed germination after ten days.

DISCUSSION

The essence of breaking the Egusi melon fruits is to create easy entry for micro organisms that will initiate fermentation of the endocarp tissue for easy extraction of seeds. Makannjuola (1972) had noted that before deciding on the best method of pod breaking that it will be necessary to understand the physical and mechanical properties of the fruit as well as the geometrical arrangement of the seeds in the endocarp. Breaking the fruit by cutting vertically and horizontally led to seed losses. However seed loss recorded from vertical cut with knife was higher. This was due to the positioning of the ellipsoidal flat seeds at almost right angle to the vertical axis of the fruit. In this position, however only few seeds were injured by cutting horizontally.

Breaking by hitting with wooden club resulted to no

Table 1. Effect of methods of Fruit breaking on number of damaged seeds/fruit.

	Methods of breaking fruit		
Replications	**Vertical cut with knife**	**Horizontal cut with knife**	**Hitting with wooden club**
1	28.90	5.63	0.00
2	29.68	6.02	0.00
3	26.30	4.88	0.00
4	30.05	6.51	0.00
5	29.60	5.98	0.00
6	26.65	5.36	0.00
Mean	28.53	5.73	0.00

F-LSD ($p < 0.05$) for comparing treatment means = 10.50.

Table 2. Effect of methods of Fruit breaking on weight of damaged seeds/fruit (g).

	Methods of breaking fruit		
Replications	**Vertical cut with knife**	**Horizontal cut with knife**	**Hitting with wooden club**
1	3.61	0.71	0.00
2	4.01	0.86	0.00
3	3.12	0.56	0.00
4	4.21	0.93	0.00
5	3.78	0.81	0.00
6	3.53	0.63	0.00
Mean	3.71	0.75	0.00

F-LSD ($p < 0.05$) for comparing treatment means = 1.70.

Table 3. Effect of methods of Fruit breaking on number of damaged seeds/plant.

	Methods of Breaking Fruit		
Replications	**Vertical cut with knife**	**Horizontal cut with knife**	**Hitting with wooden club**
1	72.25	14.08	0.00
2	74.20	15.05	0.00
3	65.75	12.20	0.00
4	75.13	16.28	0.00
5	74.00	14.95	0.00
6	66.63	13.40	0.00
Mean	71.33	14.33	0.00

F-LSD ($p < 0.05$) for comparing treatment means = 35.60.

seed damage; rather the hitting is expected to further enhanced fermentation by softening the endocarp tissue. It will, however, be pointed out that cutting with knife appears to be less laborious and takes less time to achieve when compared with hitting with club. To avoid seed losses, breaking by hitting with wooden club is recommended. Okolo et al. (2002) had reported that bruising seeds during processing results to pathogenic deterioration of the seeds and suggested the design of an efficient melon deppoding machine. Covering of the broken fruits is made to hasten fermentation by creating an environment that will be conducive to the micro organisms to cause fermentation. Covering with grass straws was found to take the least number of days to achieve fermentation while covering with black polyethylene sheet, took the highest number of days to bring about fermentation of the fruits. The result appears to suggest that grass straws cover created a favourable environment for the micro organisms responsible for fermentation of fruits. Black polyethylene sheet on the other hand delayed fermentation because the environment was not very suitable for the micro

Table 4. Effect of methods of Fruit breaking on weight of damaged seeds/plant (g).

	Methods of breaking fruit		
Replications	**Vertical cut with knife**	**Horizontal cut with knife**	**Hitting with wooden club**
1	9.03	1.78	0.00
2	10.03	2.15	0.00
3	7.80	1.40	0.00
4	10.30	2.32	0.00
5	9.45	2.02	0.00
6	8.83	1.58	0.00
Mean	9.24	1.88	0.00

F-LSD ($p < 0.05$) for comparing treatment means = 5.33.

Table 5. Effect of methods of Fruit breaking on percentage seed loss (%).

	Methods of breaking fruit		
Replications	**Vertical cut with knife**	**Horizontal cut with knife**	**Hitting with wooden club**
1	16.36	3.68	0.00
2	16.78	3.82	0.00
3	15.92	2.88	0.00
4	17.80	3.88	0.00
5	16.54	3.78	0.00
6	16.20	3.26	0.00
Mean	16.60	3.40	0.00

F-LSD ($p < 0.05$) for comparing treatment means = 12.86.

Table 6. Effect of covering material on number of days to fruit fermentation.

	Covering materials		
Replications	**Polyethylene cover**	**Grass straw cover**	**No cover**
1	12.00	8.00	9.00
2	13.00	9.00	9.00
3	12.00	9.00	10.00
4	12.00	8.00	9.00
5	11.00	9.00	10.00
6	12.00	9.00	9.00
Mean	12.00	8.67	9.33

F-LSD ($p < 0.05$) for comparing treatment means = 2.64.

organisms. Since black colour absorbs heat, it is therefore likely that the black polyethylene cover absorbed and disseminated heat to the covered materials to a level that impeded the activity of the micro organisms. It may also be attributed to poor aeration of the covered fruits. If for instance aerobic micro-organisms were involved, their activities will also be reduced. The condition of the polyethylene covered fruits was so severe that hips that were left bare fermented earlier. It will also be pointed out that covering apart from enhancing fermentation is also aimed at preventing birds from feeding on the seeds. Maynard (2001) had reported that inherent seed qualities as well as the storage conditions are factors that determine the viability of seeds. Post harvest handling, processing and storage have been indicted in loss in seed viability (Desai, 2004; Sinha et al., 2002). Germination test measured in percentage seed germination has been used for quality assessment in seeds. This study has shown that fruit fermentation using grass straws cover and no cover

Table 7. Effect of covering material on percentage seed germination (%).

Methods of breaking fruit			
Replications	**Polyethylene cover**	**Grass straw cover**	**No cover**
1	20.00	80.00	80.00
2	10.00	90.00	90.00
3	30.00	70.00	90.00
4	30.00	80.00	85.00
5	10.00	80.00	80.00
6	20.00	80.00	90.00
Mean	20.00	80.00	85.83

F-LSD ($p < 0.05$) for comparing treatment means = 42.20.

produced seeds with higher percentage germination than seeds from black polyethylene cover. This implies that covering with black polyethylene sheet must have reduced seed viability. This appears to confirm the earlier assumption that black polyethylene cover might have absorbed and disseminated heat to the covered fruits. Excessive heat probably reduced seed viability.

Seed losses and poor seed quality are problems associated with inappropriate and inefficient processing and storage methods. It is therefore recommended that melon fruit breaking by hitting with wooden club and covering with grass straws will reduce seed loss, enhance fruit fermentation and also ensure high seed viability.

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