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Effect of storage material and time to the malt quality of malt barley

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Abstract: **Storage is one of the factors that influence the quality of malt barley quality and storage conditions determine the rate at which post harvest maturation occurs. Storage of barley under appropriate environment condition removes and improves germination Teqhnequies. The malt barley variety Ibon174/03 was used for the study and five storage materials were used in the year 2018/2019. Among the storage materials there were no significant difference for moisture content, hectoliter weight ,protein and extract content at ($p<0.05$ and Fertilizer bag and Jute bag is more preferred to store long time as well as to maintain the quality of malt barley . While there were significant difference for storage time interval in extract content and hectoliter weight at ($p<0.05$). The germination energy was increased from the first storage time to one year (365 days) up to 98%germination energy. These changes increase the ability of grain to produce hydrolytic enzymes during malting and improve malt quality.**

Keywords: **storage materials, Germination Energy and malt quality.**

1. INTRODUCTION

Malts with high extract values, high enzyme activities and good modification are essential. To produce malt that meets these requirements, the barley employed must have minimal post-harvest dormancy and should germinate vigorously. The effect of storage conditions on the quality of barley is of considerable importance to the barley industry. Storage can either reduce barley quality (Woods *et al*. 1994; White *et al*. 1999), or increase malt ability (Woonton *et al.* 2002). Storage conditions largely determine the rate at which postharvest maturation occurs. Initial seed condition, seed, temperature, seed moisture content and storage time are the major factors influencing changes in malting quality.

Depending on storage conditions, Ethiopian malting barley can take several months to reach optimum malting quality. Preharvest sprouting is a serious problem in cereals (Nagao,1995), and in malting barley results in downgrading of grain and heavy financial penalties to the grower. Low dormancy of barley is closely linked to preharvest sprouting of grain (Jacobson *et al*. 2002).

The use of barley varieties with dormant genotypes reduces downgrading caused by rain and, in combination with improved harvesting practices, the risk of weather damage in rain-prone areas can be minimized (Moor 1987). However, dormancy that persists after harvest is highly undesirable because it prevents malting of newly received barley (Jacobsen *et al.* 2002).

Storage of barley under appropriate environmental conditions removes dormancy and improves germination characteristics.

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2. MATERIALS AND METHODS

Malt barley variety (Ibon 174/03) were used for storage experiment in the year 2018/2019 . Five storage materials Grain pro bag, EIAR bag , Pices Bag, Jute bag and Fertilizer bag were used and the malt quality were analyzed for each three month interval in the one year storage.

Malt barley quality analysis Method

Moisture content

five gram of ground sample in a clean dry moisture crucible were placed in oven at 105oc for three hour and the sample were allowed to cool in a desiccators to maintain the sample temperature to room temperature for 30 minute.

MC = Weight before −Weight after ∗100 /Total weight

Extract determination

Mashing procedure

The mashing process was according to the EBC congress mashing method. 55g of malt sample from each varieties were weighed (at room temperature) in to mash beaker and grinded through mill set for standardized fineness of grind. Then, ground malt was collected in same mash beaker, carefully brushing malt particles remaining in mill in to mash beaker. Mix, and without delay, the mash beaker was placed with content on balance accurate to within ±0.05g under 750g load and adjust weight of malt to 50 ± 0.05 g by removing excess in to tared dish for moisture determination. The mashing procedure was done by adding 200 mL of distilled water at 45 to 50 g of ground malt, and then the vessel was placed in a mashing apparatus. The sample was held at 45 for 30 min, then the temperature was raised to 70 by 1 for every 1-min increase for 25 min, and then 100 mL 70 distilled water was added to each sample and held at 70 for 1 h. After 10 min and 15 min (for late saccharified samples), saccharification test EBC (1998) was done with 0.02N iodine solution. At the completion of mashing, the sample was cooled to room temperature and then distilled water was added to adjust weight of the content in mash vessel to 450 g. The extract was filtered through 32 cm fluted filter paper in 20 cm funnel. The time elapsed by each sample to filter fully into a flask was recorded to determine filtration time. The density of the clear wort was determined using an wort hydrometer and expressed in degrees Plato (ºP).The extract obtained was converted and expressed in percentage on wet basis (% wb) using the following equation.

$$\text{Extract wet basis} = \frac{P(800+M)}{(100-M)}$$

Where: P is g extract in 100 g wort (Plato), M is % moisture in the malt and E is extract as wet basis.

Total protein –kjeldhal method

One gram ground sample measured and transferred into completely dry kjeldhal flask. Ten gram of kjeldhal tablet was added to the sample inside the flask. Twenty milliliter of 98% concentrated sulphuric acid was mixed with the sample. The sample digestion was started by connecting the kjeldhal flasks with the digestion rock (2000 FoodALYT SBS). And the digestion was completed when the brown color of the sample was completely disappeared. After the digested sample was cooled, 250 ml of distilled water and 70 ml of sodium hydroxide (32%) were added and distilled into 25ml of excess boric acid containing 0.5ml of screened indicator. The distillate was titrated with 0.1N hydrochloric acid to the red end point.

$Total\ nitro\text{gen}(N\%)$ = T−B ∗0.1401/ W(100−Mc) ,

W is weight of the sample taken for analysis

T is volume of HCl used for titration

B is blank used as control

Crude protein (CP %) = N*6.25

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3. RESULT

Table 1: Effect of storage material to the quality of malt barley store for one year.

Storage material	Malt quality			
	MC	HLW	extract	protein
Grain probag	11.3±1.41	63.35±0.07	77.25 ± 2.77	11.38 ±1.14
EIAR bag	12 ±1.92	63.25 ± 0.07	76.95 ±5.16	12.22 ±0.25
Pices Bag	11.45 ± 1.3	63.25 ± 0.25	76.07 ±3.73	11.51 ± 1.6
Jute bag	12.2±1.97	62.9 ± 0.42	77.9 ±4.07	12.02 ± 1.11
Fertilizer bag	11.55 ± 1.2	63.4 ± 0.56	75.89± + 4.57	12.18 ± 0.12

MC=moisture content HLW = Hectoliter weight

Table 2: Effect of storage time to the quality of malt barley store for one year

Storage material	Malt quality			
	MC	HLW	extract	protein
After harvest	12.7 ± 1.25	62.3 ± 0.00b	81.48 ± 1.93a	13.11 ± 0.33
3 month storage	12.7 ±1.13	63.05 ± 0.35ab	79.44 ± 0.82ab	13.03 ± 1.0
6 month storage	11.2 ± 1.27	62.85 ± 0.77ab	78.12 ± 4.00abc	11.78 ± 1.7
9 month storage	10.55 ± 0.07	63.5 ± 0.14a	73.36 ± 0.09c	11.2 ± 1.17
12 month storage	10.75 ± 0.07	63.5 ± 0.42a	73.84 ± 1.6bc	11.66±0.60

MC=moisture content HLW = Hectoliter weight

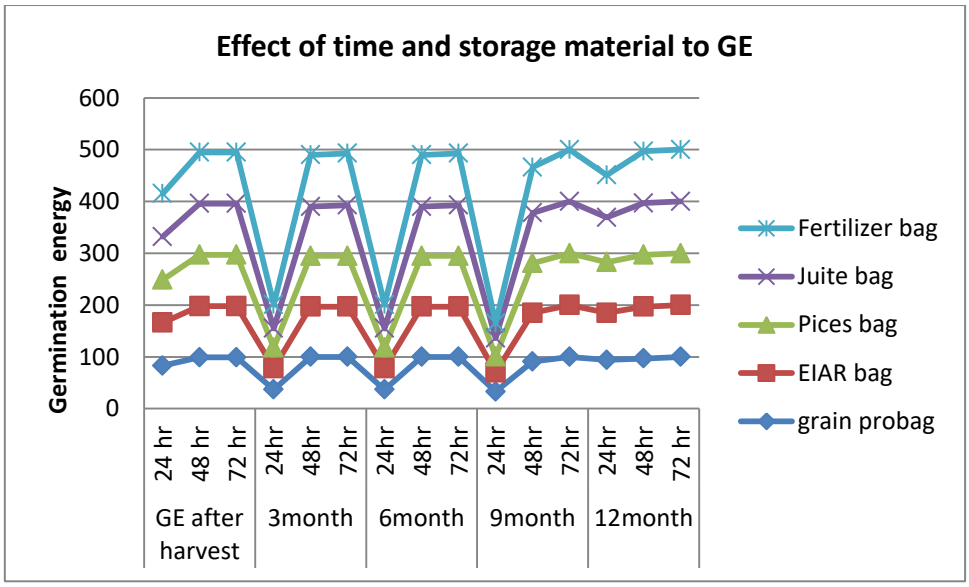

Fig 1: Germination energy percentage for different storage material in one year.

4. DISCUSSION

Effect of storage material to the quality of malt barley store for one year there were no significant difference among the five storage materials (Grain probag , EIAR bag , Pices Bag , Jute bag and Fertilizer bag) for moisture content at ($p<0.05$). The moisture content for Jute bag(12.2%) and EIAR(12%) which were higher due to the nature of the materials while the other storage materials (Grain probag , Pices Bag , Fertilizer bag) were lower moisture content compared to Jute bag and EIAR bag.

Effect of storage time to the quality of malt barley store for one year there were no significant difference among the five storage time interval (after harvest , three month, six month , Nine month and Twelve month) storage for moisture content at ($p<0.05$). The moisture content after harvest to Tewlve month was decrease from 12.7% to 10.55% which showed that the moisture content of malt barley grain stored for long period the moisture content decrease under controlled condition. Gaston et al. (2009) considered that grain M.C., grain temperature, grain temperature fluctuation magnitude and storage time affect the magnitude of M.C. stratification. On the other hand Ochandio et al. (2009) did not find moisture content stratification in 12% moisture content barley silo bags, even after 1 year of storage

The effect of storage materials to the quality of malt barley store for one year there were no significant difference among the five storage materials for hectoliter weight while there were significant difference between the time interval for Hectoliter content at ($p<0.05$).

There were significant difference for storage time interval in extract content while there were no significant difference among the storage materials at ($p<0.05$).The extract content for grain probag (77.25%) and jute bag (77.9%) higher than compared to the other storage materials.

It is well established that extractable substances from malt and hence extract values are influenced by the extent of endosperm cell wall and protein modification during malting

There were no significant different among the storage materials and between time interval for protein content at $p<0.05$. The protein content decrease when the storage time becoming long and long from after harvest to Twelve month storage.

There is germination change or increase when the time of storage becoming long and long. The germination energy increase when the time increases comparing the five storage material for fertilizer bag and jute bag were higher germination value which shows that the extract content increase due to the increase in enzyme activity. Germination for 24hr, germination for 48hr and GE for 72hr increase gradually from the first time interval up to twelve month Germination test.

5. CONCLUSION

It is concluded from this study that Ethiopian barley grains can change significantly during storage at room temperature for up to one year (365) days, these changes can significantly increase the rate of barley grain germination (as measured by the GE), these changes can significantly increase the ability of the grain to produce hydrolytic enzymes during malting and improve malt quality parameter and Fertilizer bag and Jute bag is more preferred to store long time as well as to maintain the quality of malt barley. The Germination energy correlates malting and with final malt quality.

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