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Studies on different storage structures on the shelf-life of *Hurrihittu* (Ragi value added product) against *Sitophilus oryzae*

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ABSTRACT

Finger millet (*Eleusine corcana*) is a small millet and quick growing crop, particularly suited to a dry continental climate. Finger millet value added products enhances the bioavailability of nutrients, but also improves the overall nutritional quality of grains. Diversification of diet is necessary to overcome the nutritional situation in the country. The ragi value added products infested by the storage pests lead to the qualitative and quantitative losses to overcome this losses. So, the study was conducted to know the shelf-life of *Hurrihittu* against *Sitophilus oryzae* on different storage structure like cloth bag, polythene cover, mud container, glass container and steel container. It was observed that *Hurrihittu* stored in the cloth bag recorded maximum numbers of insects and *Hurrihittu* stored in glass container was free from infestation till 150 days and infestations was recorded at 180 days. Shelf-life of *Hurrihittu* in cloth bag was less, whereas, *Hurrihittu* stored in steel container showed longer shelf-life.

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INTRODUCTION

Finger millet [*Eleusine coracana* (L.) Gaertn] is one of the ancient millets in India (2300 BC), of all the cereals and has highest amount of calcium (344 mg %) and potassium (408 mg %). It has highly dietary fibre, minerals and sulphur containing amino acids compared to white rice, current major staple food of Africa and Asia, which is widely grown in semi-arid and arid tropics. Incidentally, the arid and semi-arid zones that are primarily affected by water deficit, have traditionally contributed around 40 per cent of the total production of all categories of food grains. Finger millet survives under severe water-deficit and osmotic stress and shows remarkable recovery on alleviation of stress (Govind *et al.*, 2009). Although, this crop is adapted to resist severe drought (Govind *et al.*, 2009), little is known about its mechanisms of osmotic adjustment and ability to repair the damage caused by drought-induced oxidative stress.

Finger millet value added products enhances the bioavailability of nutrients, but also improves the overall nutritional quality of grains. It is a storehouse of digestive enzymes and low molecular weight carbohydrates which reduces the water holding capacities of foods. Consequently, the liquid food will be low in dietary bulk but high in nutrient density. Diversification of diet is necessary to overcome the nutritional situations especially in the developing countries like India. More so, micronutrient malnutrition is affecting the working capacities and also the serious consequences like growth deficits, child deaths, cognitive development etc.

People are now becoming very health conscious and would like to consume foods containing high fibre, low fat and other protective nutrients. Some of the ragi value added products made from millets contain high fibre content and low fat and expected to find a place among healthy foods. Enrichment of value added products with proteins, vitamins, minerals, micronutrients and other vegetable sources such as pulses and soybeans further increases its nutritive value.

About 15 per cent of the grains stored after each harvest is believed to be lost due to the ravages of rats, insects, mites and other microbial agents (Walter, 1971). Neelakanthan (1972) claimed that the annual loss of food grains in the Indian godowns as a result of insect infestation was about 5 million tons.

In case of Ragi value added product *Hurrihittu* infested by the pest, *S. oryzae* quantitative as well as qualitative losses occur. To safe guard the quality and quantity of *Hurrihittu*, there is a need to manage this pest very effectively in the storage. Hence, to manage this pest, study was designed to improve the shelf-life of *Hurrihittu* by identifying a suitable storage structures.

MATERIAL AND METHODS

The present investigation was conducted during 2009-2010 at Entomology Laboratory of the Project Co-ordination Centre of the All India co-ordinated Small Millet Improvement Project, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru (AICRP on small millets, UAS, GKVK, Bengaluru).

Two hundred grams of Ragi value added product *Hurrihittu* was taken in a different containers such as cloth bag (T_1) polythene cover (T_2) glass container (T_3) mud containers (T_4) and steel container (T_5). It was replicated four times. These samples were observed at an interval of 30 days to 180 days to assess the pest infestation. The data thus collected in the study were analyzed statistically using Complete Randomized Design two factorial designs.

RESULTS AND DISCUSSION

The *Hurrihittu* stored in cloth bag (T_1) infested with *S. oryzae* at 30 days, recorded 4.25 insects followed by 22.50, 37.00, 50.00, 57.00 and 65.00 insects at 60, 90, 120, 150 and 180 days, respectively and differed significantly. While the same produce stored in polythene covers (T_2) recorded (12.00) insects at 120 days followed by 20 and 24 insects at 150 and 180 days, respectively, which also differed significantly (Table 1).

When the produce was stored in glass container (T_3) recorded 5.00 insects at 180 days and differed significantly at a duration period. Similarly, the produce when stored in mud containers (T_4), *S. oryzae* incidence was 14.25 at 90 days followed by 25, 30 and 35 insects at 120, 150 and 180 days, respectively which differed significantly.

However, the produce stored in steel container (T_5) was free from *Sitophilus oryzae* attack till 150 days. However, recorded lower (3.00) incidence at 180 days and differed significantly.

Among the different storage structures, the produce stored in cloth bag (T_1) was attacked by *S. oryzae* at 30 days, while in other containers, there was no incidence of insect attack and differed significantly. Almost, the similar trend was observed among the storage structures at 60 days after storage. At 90 days, cloth bag (T_1) recorded the maximum of 37 insects followed by mud container (T_4) and differed significantly while there was no incidence in other treatments. Similarly, at 120 days, cloth bag (T_1) recorded the maximum (50.00) *S. oryzae* attack followed by mud container (T_4) and polythene cover (T_2) and differed significantly. There was no incidence of *Sitophilus oryzae* in glass (T_3) and steel (T_5). At 150 and 180 days also, the produce stored in cloth bag (T_1) recorded the maximum number of insects followed by mud container (T_4) and polythene cover (T_2). There was less incidence in glass (T_3) and steel container (T_5).

Almost the same trend was observed at 150 days after storage in all the storage containers. At 180 days cloth bag

Table 1: Shelf-life of *Hurrihittu* against *Sitophilus oryzae*

Insect species	Storage structure	0	30	60	90	120	150	180	Mean
S. oryzae	T_1	0.00 (0.70)	4.25 (2.17)	22.50 (4.78	37.00 (6.12)	50.00 (7.10)	57.00 (7.58)	65.00 (8.09)	33.67 (5.22)
	T_2	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	12.00 (3.53)	20.00 (4.52)	24.00 (5.04)	8.14 (2.27)
	T_3	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	5.00 (2.34)	0.71 (0.94)
	T_4	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	14.25 (3.83)	25.00 (5.04)	30.00 (5.52)	35.00 (5.95)	14.89 (3.21)
	T_5	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	3.00 (1.86)	0.042 (0.87)
	Mean	0.00 (0.70)	0.85 (0.99)	4.50 (1.52)	10.25 (2.41)	17.40 (3.42)	21.40 (3.80)	26.60 (4.66)	
	F-value*								
			A			B		AB	
S.E. ±			0.20			0.17		0.45	
C.D. (P = 0.01)			0.56			0.48		1.27	

Figures in parenthesis are $\sqrt{x+0.5}$ transformed values; T_1= Cloth bag, T_2= Polythene cover. T_3= Glass container, T_4= Mud container, T_5= Steel container

(T_1) recorded the maximum 65 insects followed by mud container (T_4) (35) and polythene cover (T_2) (24). There was less incidence in T_5 (3.00) and T_3 (5.00) which differed significantly also (Table 1).

Hurihittu stored in cloth bag was infested with *Sitophilus oryzae* at 30 days and gradually increased upto 65 insects/sample at 180 days. While the same produce stored in polythene cover was free from insect infestation up to 90 days and recorded the pest infestation up to 24 insects at 180 days; later, increased gradually. Similarly the *Hurihittu* stored in glass container was free from insect infestation till 150 days and infestation was recorded at 180 days. While the same stored in mud container infested at 90 days and increased gradually at 180 days; while the same produce stored in steel container was free from *Sitophilus oryzae* attack till 150 days and later recorded lower incidence at 180 days Suchitra Kumari and Subramanya (2013).

Among the different storage structures, the produce stored in cloth bag was infested with *S. oryzae* at 30 days while in other containers no insect attack was noticed. Almost similar trend was observed among the storage structure at 60 days after storage. Similarly the produce stored in cloth bag recorded the maximum infestation at 90, 120, 150 and 180 days after storage compared to the other storage structures such as polythene cover, glass container, mud container and steel container. Further, lowest incidence was observed in steel container followed by glass container, polythene cover and mud container (Fig. 1).

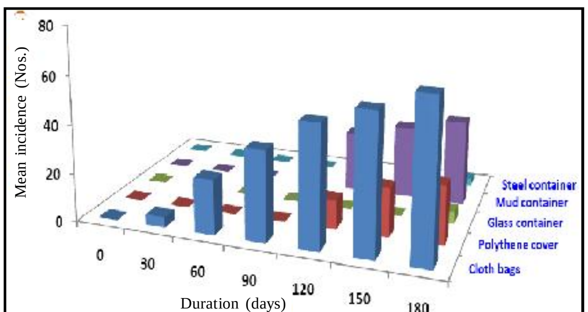

Fig. 1 : Shelf-life of *Hurihittu* against *S. oryzae* on different storage structures

The highest infestation recorded in cloth bag, may be due to the increase in moisture content and oxygen requirement of insect was abundantly met and led to rapid multiplication. The lowest infestation was recorded in steel container, this may be due to the air tightness and low moisture content and that retarded the growth and development. The findings are in closed agreement with Dhaliwal (1977); Dass (1977); Agrawal *et al.* (1981); Khound and Borah (1984); Sonelal and Srivastava (1985); Suchitra Kumari and Subramanya (2013) and Singh and Yadav (1995), who have also reported that the steel container was best; further, bag storage was the worst affected storage system.

The present study slightly differs with the observation of Borikar *et al*. (1977), who have observed that the grains stored in Kangi were heavily infested with rice weevil, lesser grain borer, pulse beetle and red flour beetle than bagged commodities. However, the infestation of grain moth, flat grain beetle and rice moth was more in bagged produce.

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