



An Evaluation of Infestation of Insect Pests of Flours in Benin City, Edo State, Nigeria

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ABSTRACT: Wheat, Yam, Cassava and Corn flour obtained during fortnightly interval for three months in Benin City, Edo State, were investigated for the occurrence and relative abundance of various insect pests. Six species of insect pests were recorded. They includes, *Tribolium castaneum*, *sitophilus oryzae*, *Dinoderus porcellus*, *Oryzaephilus surinamensis*, *Araecerus fasciiculatus* and *tenebrioides mauritanicus*. The infestation survey shows *Trilobolium castaneun* as a major pest of wheat flour. Other insect pests found are *Tenebrioides mauritanicus* and *Dinoderus porcellus* as indicated by their mean number and Percentage abundance of individual species in this study but *Sitophilus oryzae* does not thrive in wheat flour. *Araecerus fasciiculatus* is the major pest of yam and cassava flours while infestation of *Tribolium castanuen* in Corn flour was the highest. *Oryzaephilus surinamensis* and *Sitophilus oryzae* occur sporadically in flours. © JASEM

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Insects are pests when they reduce the quantity and quality of food, forage, feed on fibre during production, damage commodity during harvesting, processing, marketing, storage or use and they also transmit disease organisms to man or valuable plants and animals (Gullan and Cranston, 2005; Charles and Norman, 2005).

Insects infesting stored foods are one of the most common household insect problems. The many different kinds of insects that invade stored dried foods are often referred to as "pantry pests. Stored food product may become infested at the processing plant or warehouse, in transit, at the store, or right in your home. Most of the stored food insects also are pests of stored grain or other commodities and may be relatively abundant outdoors. Food products that are left undisturbed on the shelves for long periods are particularly susceptible to infestation. However, foods of any age can become infested (Davidson and William, 1979; Morallo-Rejesus, 1978).

Insect pests of flours are insects which affect flours specifically and they include the flour beetle "*Tribolium confusum*" (confused flour beetle) and "*Tribolium castaneum*" (Red flour beetle), often referred to as brain bugs because they are common in milling operations. The Mediterranean Flour Moth(*Ephestia kuehniella*), Indian meal Moth (*Plodia interpunctella*), *Sitophilus oryzae*, *Oryzaephilus surinamensis*, *Araecerus fasciiculatus* and *Tenebrioides mauritanicus*. Many of these insects develop and reproduce within the stored flours and derive all the nutrients they require from the stored food. The aim of this study is to investigate the different insect pests of flour in Benin City and to

determine their percentage abundance in the various flour samples.

MATERIALS AND METHODS

The Studied Area is Benin City. Benin City is the Capital of Edo State. It has a temperature range of 21.1°C - 32.2°C. It is a tropical rainforest zone with two main seasons (From May – October is raining season and November - April is dry season) occurring during the year. About 500 g of infested samples of yam, corn, wheat and cassava flours were collected from stores at Obowa Street, off Akpakpava Road, Bucha Street, off Forestry Road, Uselu market and New Benin Market all in Benin City, Edo State. Sampling was carried out at forth-nightly intervals (every two weeks) from August to October, 2010. This was done between 10am - 12am on sampling days.

About 500 g of infested samples of yam, corn, wheat and cassava flours collected from stores and markets in Benin City were isolated using sieves. While sieving, the flour granules passed through the sieve but the insect pest remained on the sieve and were subsequently collected by hand picking. The insect pests were killed in a Killing jar of about 250ml. The bottle (Killing jar) has a layer of cotton wool to which chloroform is poured for about 20 min; the insect pests left in the bottle and subsequently removed. The preservation was done by placing specimens in specimen bottles which contained 70% alcohol with some glycerol to prevent stiffening of the specimens. The insect pest collected from the 500g of each infested samples of flours were counted and recorded.

The identification of the different insect pests was done by marching samples collected with referenced works from the internet, the museum of Crop science, Faculty of Agriculture, University of Benin and while heating and weighing methods were used to determine the moisture content of the flours in Agric laboratory. About 1g of each infested flour was put in a crucible and was first weighed on a beam balance before subjecting to heating in an oven set at temperature of 105°C till a constant weight was obtained after series of heating and weighing each infested flour. The moisture content determination is very important because each insect pest is only capable of affecting flour with certain moisture content range.

RESULT AND DISCUSSION

The infestation survey shows that the insect pests associated with flour in Benin City are *Trilobium castanuen*, *Araecerus fasciiculatus*, *Dinoderus porcellus*, *Tenebrioides mauritanicus*, *Sitophilus Oryzae* and *Oryzaeophilus surinamensis*. The survey shows *Trilobium castaneun* as the major pest of wheat flour (Table 1) having a mean number of 11.33 insect pests per 500 g of infested flour and 60% percentage abundance for station I (Figure 1). *Araecerus fasciiculatus* is the second major insect pest of wheat flour (Table 1) having a mean number of 3.5 insect pest per 500 g and 18% abundance of individuals for station I (Figure 1). Other insect pests found on wheat flour are *Tenebroides mauritanicus* and *Dinoderus porcellus* but *Sitophilus oryzae* does not thrive in wheat flour.

The mean number of 13.33 insect pests per 500 g and 68% percentage abundance for station III (Table 3 and Figure 3).

Araecerus fasciiculatus is a major pest of yam (Table 5) having a mean number of 17.83 insect pests per 500g of infested flour and 69% percentage abundance for station I (Figure 5) and mean number of 13.17 insect pests per 500 g (Table 7) and 60% percentage abundance for station III (Figure 7). *Araecerus fasciiculatus* is also the major pest of cassava flours (Table 9) having a mean number of 19.33 insect pests per 500 g of infested flour and 72% percentage abundance (Figure 9) for station I and mean number of 15.83 insect pests per 500 g (Table 11) and 72% percentage abundance (Figure 11) for station III. Other insect pests associated with yam and cassava flours are *Dinoderus porcellus*, *Trilobium castanuen* and *Tenebriodes mauritanicus*.

Infestation survey of corn flour shows *Trilobium castanuen* as the major pest (Table 14) having a mean number of 35 insect pests per 500g of infested flour and 91% percentage abundance (Figure 14) for Station II and mean number of 27.17 insect pests per 500 g (Table 16) and 92% percentage abundance (Figure 16) for station IV. The infestation in corn flour recorded the highest number of pests (Table 14 and Figure 14). However, some insect pest such as *Araecerus fasciiculatus*, *Dinoderus porcellus* and *Sitophilus oryzae* do not thrive on this flour (Table 14 and Table 16).

Table 1: Infestation survey of wheat flour in station I

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaeophilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	3	2	0	0	1	8
2	5	2	0	0	0	12
3	12	8	0	0	5	22
4	0	0	1	0	0	0
5	2	0	0	0	3	12
6	0	2	0	0	3	14
Total	23	12	1	0	12	68

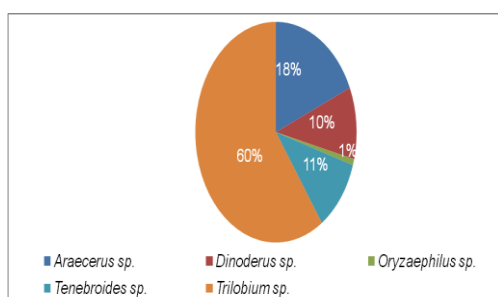


Fig 1: Percentage (%) abundance of individuals species of wheat flour in station I

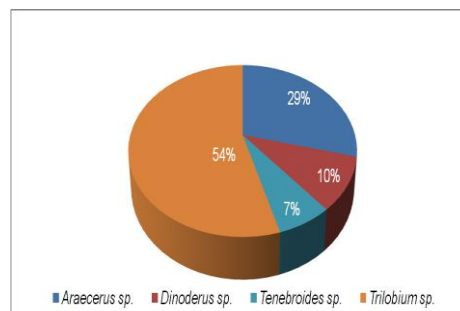


Fig 2: Percentage (%) abundance of individuals species of wheat flour in station II

Table 2: Infestation survey of wheat flour in station II

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaeophilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	0	0	0	0	0	4
2	0	1	0	0	0	3
3	4	0	0	0	0	8
4	5	5	0	0	3	14
5	9	0	0	0	1	17
6	15	6	0	0	4	19
Total	33	12	0	0	8	65

Table 3: Infestation survey of wheat flour in station III

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaeophilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	8	3	0	0	2	17
2	3	0	2	0	3	8
3	0	0	2	0	0	12
4	0	0	0	0	0	22
5	2	7	0	0	1	13
6	3	2	0	0	0	8
Total	16	12	4	0	6	80

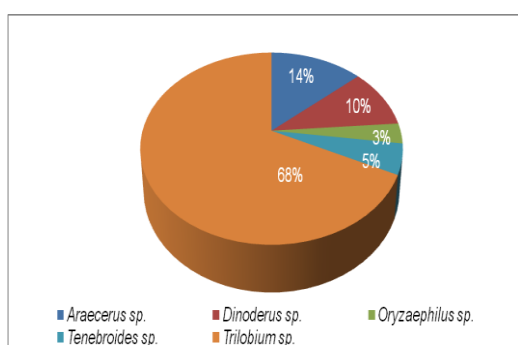


Fig 3: Percentage (%) abundance of individual's species of wheat flour in station III

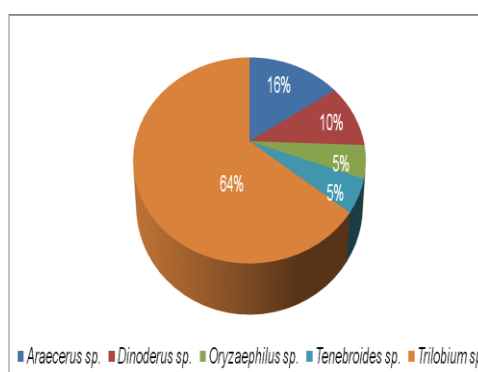


Fig 4: Percentage (%) abundance of individual's species of wheat flour in station IV

Table 4: Infestation survey of wheat flour in station IV

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaeophilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	7	2	0	0	2	14
2	0	0	1	0	2	4
3	0	0	3	0	0	7
4	2	0	0	0	0	0
5	0	5	0	0	0	19
6	3	1	0	0	0	6
Total	12	8	4	0	4	50

Table 5: Infestation survey of yam flour in station I

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaeophilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	7	0	0	0	2	1
2	18	3	0	0	0	1
3	13	5	0	0	0	1
4	20	8	0	0	1	3
5	21	11	0	0	0	0
6	28	4	0	0	3	4
Total	107	31	0	0	6	10

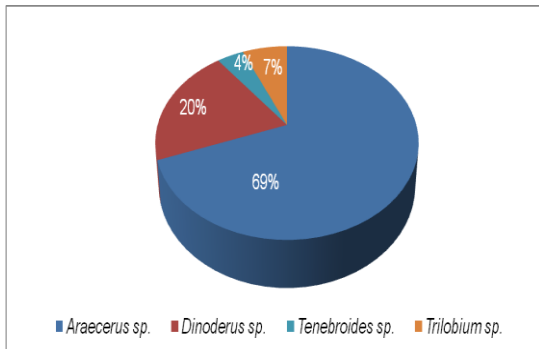


Fig 5: Percentage (%) abundance of individual's species of yam flour in station I

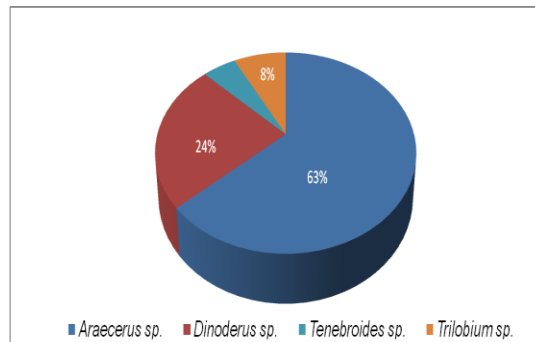


Fig 6: Percentage (%) abundance of individual's species of yam flour in station II

Table 6: Infestation survey of yam flour in station II

Replicate No	Araecerus sp	Dinoderus sp	Oryzaephilus sp	Sitophilus sp	Tenebroides sp	Trilobium sp
1	28	24	0	0	0	2
2	6	0	0	0	1	0
3	9	2	0	0	4	0
4	8	1	0	0	0	4
5	17	3	0	0	2	0
6	22	4	0	0	0	5
Total	90	34	0	0	7	11

Table 7: Infestation survey of yam flour in station III

Replicate No	Araecerus s p	Dinoderus sp	Oryzaephilus sp	Sitophilus sp	Tenebroides sp	Trilobium sp
1	18	18	0	0	0	7
2	1	1	0	0	2	0
3	12	0	0	0	0	0
4	15	4	0	0	0	3
5	28	7	0	0	0	7
6	5	1	0	0	0	2
Total	79	31	0	0	2	19

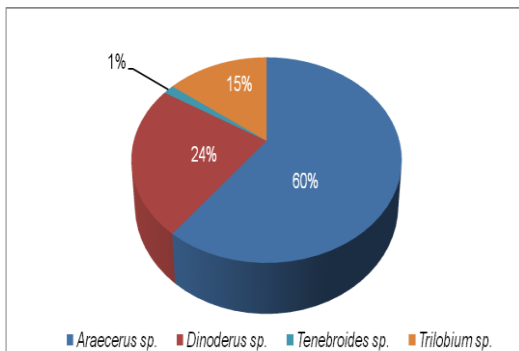


Fig 7: Percentage (%) abundance of individual's species of yam flour in station III

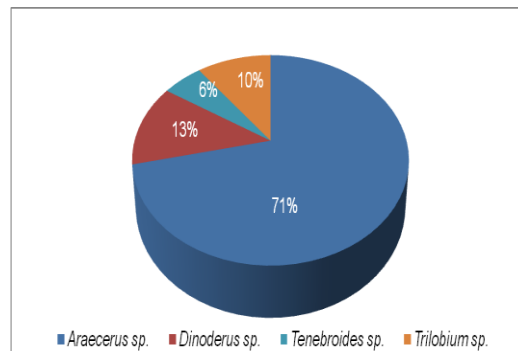


Fig 8: Percentage (%) abundance of individual's species of yam flour in station IV

Table 8: Infestation survey of yam flour in station IV

Replicate No	Araecerus sp	Dinoderus sp	Oryzaephilus sp	Sitophilus sp	Tenebroides sp	Trilobium sp
1	26	4	0	1	0	3
2	14	8	0	0	0	4
3	28	1	0	0	1	4
4	9	2	0	0	0	1
5	4	0	0	0	4	0
6	9	1	0	0	2	1
Total	90	16	0	1	7	13

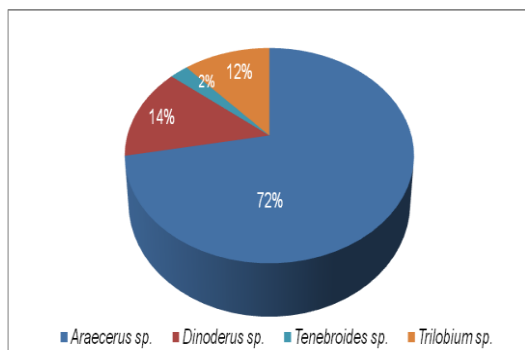


Fig 9: Percentage (%) abundance of individuals species of cassava flour in station I

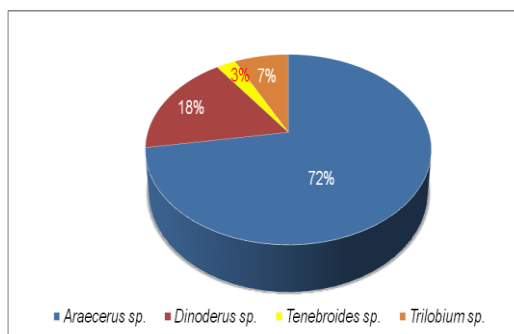


Fig 10: Percentage (%) abundance of individuals species of cassava flour in station II

Table 9: Infestation survey of cassava flour in station I

Replicate No	Araecerus sp	Dinoderus sp	Oryzaephilus sp	Sitophilus sp	Tenebroides sp	Trilobium sp
1	32	10	0	0	3	8
2	6	0	0	0	0	0
3	10	3	0	0	0	1
4	14	3	0	0	0	2
5	22	0	0	0	0	2
6	32	7	0	0	1	6
Total	116	23	0	0	4	19

Table 10: Infestation survey of cassava flour in station II

Replicate No	Araecerus sp	Dinoderus sp	Oryzaephilus sp	Sitophilus sp	Tenebroides sp	Trilobium sp
1	10	0	0	0	1	3
2	14	1	0	0	1	5
3	14	4	0	0	3	0
4	23	6	0	0	0	2
5	36	9	0	0	0	2
6	42	14	0	0	0	2
Total	139	34	0	0	5	14

Table 11: Infestation survey of cassava flour in station III

Replicate No	Araecerus sp	Dinoderus sp	Oryzaephilus sp	Sitophilus sp	Tenebroides sp	Trilobium sp
1	12	2	0	0	0	4
2	40	9	0	0	0	1
3	15	2	0	0	2	0
4	14	1	0	0	0	3
5	7	3	0	0	2	5
6	7	0	0	0	0	3
Total	95	17	0	0	4	16

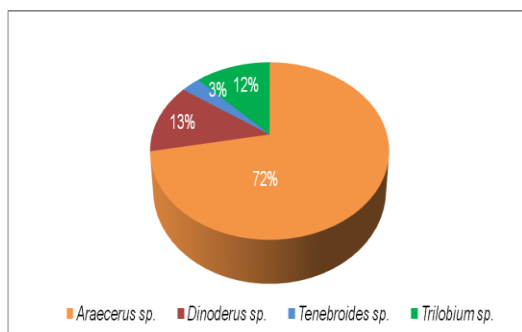


Fig 11: Percentage (%) abundance of individual's species of cassava flour in station III

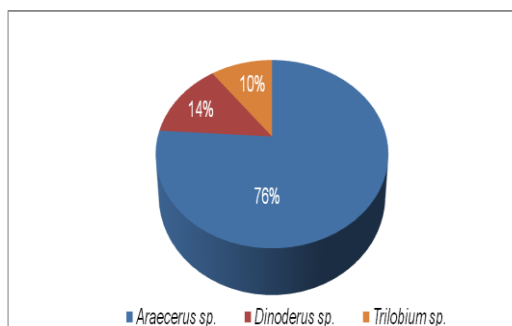


Fig 12: Percentage (%) abundance of individuals species of cassava flour in station IV

Table 12: Infestation survey of cassava flour in station IV

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaephilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	13	2	0	0	0	0
2	12	2	0	0	0	1
3	26	7	0	0	0	5
4	18	1	0	0	0	4
5	13	0	0	0	0	1
6	7	4	0	0	0	1
Total	89	16	0	0	0	12

Table 13: Infestation survey of corn flour in station I

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaephilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	0	0	2	0	5	75
2	0	0	3	0	2	42
3	0	0	1	0	3	75
4	0	0	3	0	0	36
5	0	0	5	0	0	18
6	0	0	2	0	0	15
Total	0	0	16	0	10	264

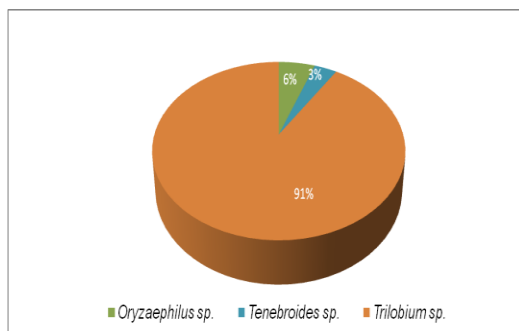


Fig 13: Percentage (%) abundance of individual's species of corn flour in station I

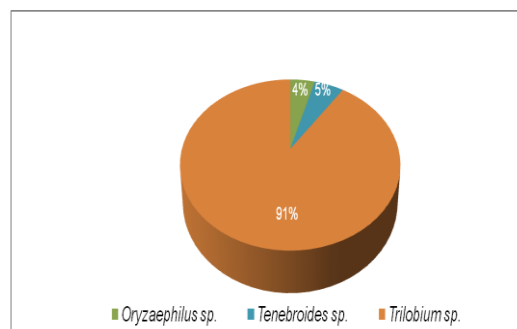


Fig 14: Percentage (%) abundance of individual's species of corn flour in station II

Table 14: Infestation survey of corn flour in station II

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaephilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	0	0	3	0	3	12
2	0	0	2	0	0	22
3	0	0	3	0	7	40
4	0	0	3	0	2	42
5	0	0	0	0	0	56
6	0	0	0	0	0	38
Total	0	0	10	0	12	210

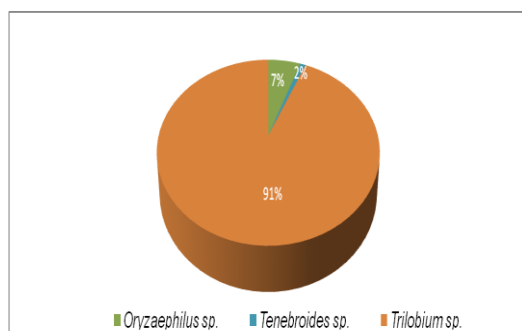


Fig 15: Percentage (%) abundance of individual's species of corn flour in station III

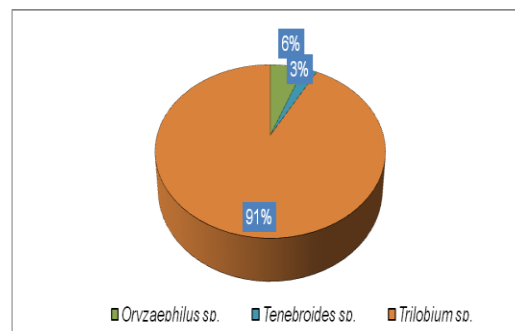


Fig 16: Percentage (%) abundance of individual's species of corn flour in station IV

Table 15: Infestation survey of corn flour in station III

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaephilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	0	0	0	0	1	31
2	0	0	1	0	0	18
3	0	0	2	0	2	23
4	0	0	2	0	0	24
5	0	0	7	0	1	46
6	0	0	0	0	0	26
Total	0	0	12	0	4	168

Table 16: Infestation survey of corn flour in station IV

Replicate No	<i>Araecerus</i> sp	<i>Dinoderus</i> sp	<i>Oryzaephilus</i> sp	<i>Sitophilus</i> sp	<i>Tenebroides</i> sp	<i>Trilobium</i> sp
1	0	0	2	0	4	47
2	0	0	1	0	0	15
3	0	0	2	0	0	27
4	0	0	2	0	1	42
5	0	0	3	0	1	22
6	0	0	0	0	0	10
Total	0	0	10	0	6	163

The infestation survey shows that the insect pests associated with flour (wheat, corn, cassava and yam) in Benin City are *Trilobium castaneum*, *Araecerus fasciculatus*, *Dinoderus porcellus*, *Tenebroides mauritanicus*, *Sitophilus oryzae* and *Oryzaephilus surinamensis*. It was found that more than one insect pest affects a particular flour. Hence, insect pests of flour are said to exhibit low host specificity and the level of infestation is higher in some in relation to the others (Osuji, 1980; Davey, 1965; Rossiter, 1970).

Trilobium castaneum is a major insect pest of wheat flour (Lyon and William, 2008). In the wheat flour, *Araecerus fasciculatus* is a second major pest while *Dinoderus porcellus* and *Tenebroides mauritanicus* occurred. The main factors which contribute to infestation are attributed to residual populations from old stock, unclean storage containers, unhygienic condition of the warehouse and flour with high moisture content. Many of the storage pests feed on other dried products as well as flours. This can often lead to cross infestation of stored products and attention must be paid to hygiene of all stored products (Krischik and Vera, 1995).

Araecerus fasciculatus is the major insect pest of cassava and yam flour (Buss and Fasulo, 2006). *Dinoderus porcellus* and *Trilobium castaneum* are the second and third major insect pests of yam and cassava flours respectively. *Oryzaephilus surinamensis* also occurred sporadically. The moisture content of flours serves as a determinant in relation to the ability of the insect pests to survive and proliferate progressively. Hence, with the moisture content of approximately 16% and 19% for yam and cassava flour respectively enhances proliferation of insect pest insect. The availability of nutrients in the different flours assisted the overwhelming presence of most of the insects' pests. It is also a pointer to the fact that insect pests cannot live in a medium devoid of nutrients. Unhygienic

condition of the warehouse also contributes to infestation (Osuji, 1980).

The infestation of *Trilobium castaneum* in corn flour has the highest level of insect pest infestation not just for number of insects present in the corn flour but among the insect pests surveyed so far in the course of this project work. However, this high dominance in corn flours is followed by the infestation of *Tenebroides mauritanicus*. *Oryzaephilus surinamensis* is also found in the corn flour but the level of infestation is low.

Infestation by *Sitophilus oryzae* was found in most of the flours but all through the survey, it was also found to maintain the least level of infestation. In general, the main factors which contribute to infestation are attributed to residual populations from old stock, unclean storage containers, unhygienic condition of the warehouse with high moisture content, mix-up of bags of flours in stores and markets, lack of knowledge of the insect pests and alternate hosts. Many of the storage pests feed on other dried products as well as flours.

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