

# Insect pests of dried date palm (*Phoenix dactylifera* L.) fruits sold in selected markets in Zaria, Kaduna State, Nigeria

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## Abstract

The insect pests infesting date palm fruits in Zaria, Nigeria were investigated. The samples were obtained from Samaru, Tudun Wada, Zaria city, Dan Magaji, and Sabon Gari markets in Zaria. Purchased dates were opened using forceps to survey the existing adult insect species, larvae, and pupae in the fruits. Rearing of the larvae and pupae was carried out by subjecting them to an artificially prepared diet and allowed to emerge into an adult for identification. Date palm fruits obtained from Dan Magaji were mostly infested (36.9%), followed by those obtained from Samaru (32.9%), Tudun Wada (32.3%), and Zaria City (32.1%), and the lowest in Sabon Gari (29.5%). Six insect pests species were obtained after rearing the larvae to adults and include *Oryzaephilus surinamensis* (47.4%), *Tribolium confusum* (21.1%), *Lexostege nudalis* (10.5%), *Carpophilus hemipterus* (7.9%), *Dinoderus* Sp. (7.9%), and *Aphthona whitefieldi* (5.3%). Any dried date palm fruit with a hole must be likely to contain infesting adult insects or their larvae which may harbour pathogenic organisms.

**Keywords:** Dried date palm fruits; Insect Pests; Infestation; Insect rearing; Zaria-Kaduna, Nigeria

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## **INTRODUCTION**

Dates are edible fruits of the date palm (*Phoenix dactylifera* L.) of the family Arecaceae. They are a staple food in arid and semi-arid regions of North Africa, the Middle East, and South-Asian countries (Chandrasekaran and Bahkali, 2013). The fruits are highly nutritious as they contain carbohydrates (44-88%), fats (0.2-0.4%), fiber (6.4-11.5%), minerals (oil, calcium, sulfur, iron, potassium, phosphorous, manganese, copper, and magnesium), vitamins, a higher concentration of protein (2.3-5.6%) compared with other major cultivated fruits such as apples, oranges, bananas and grapes that contain only 0.3 %, 0.7%, 1.0 % and 1.0 % of protein respectively (Elleuch *et al.*, 2008). Dates have always played an important role in the economic and social lives of the people. The vitamins include; thiamin, riboflavin, niacin, folate, vitamin A and vitamin K. Mineral analysis showed a higher concentration of K followed by P, Mg, Ca, and Na (Hadarmi, 1999). The date fruit is a one-seeded berry consisting of a fleshy mesocarp covered by a thin epicarp and a hard endocarp surrounding the seed. Health specialists have said that eating one date per day is necessary for a balanced and healthy diet.

Date palms are attacked by various insect pests and pathogens and their nature and severity vary with cultivar, geographic location, weather, and cultural practices (Howard *et al.*, 2001; Zaid *et al.*, 2002). Quality indices developed to assess date fruit quality include fruit size, shape, color, texture (chewiness), cleanliness, and freedom from defects (such as sunburn, skin separation, insect damage, sugar migration to fruit surface, and fermentation) and decay-causing pathogens. The drying of the fruits helps in prolonging their lifespan, hence making the commodities available at all seasons and also minimizes their deterioration by insect pests and micro-organisms (Lale, 2002). Drying fruits help farmers sell the products during the off season at a higher price (Degri, 2007). The drying of the fruits helps in reducing the moisture content to about 9-12% therefore, minimizing the activities of storage insect pests and pathogens (Okunade *et al.*, 2001; Lale, 2002). However, there is numerous insect pest associated with poor storage of dried fruits (Lale, 2002; Walter, 2002; Williams *et al.*, 2002) especially in northern Nigeria, and these affect the quality and economic values of date palm fruits. Hence this study is aimed at assessing the quality and incidence of insect pest spoilage of date palm fruits collected from selected markets in Zaria, Kaduna state, Nigeria.

## **MATERIALS AND METHODS**

### **Study Area**

The research was conducted at the five markets within Zaria, Kaduna state, Nigeria. Zaria is located approximately on latitude 11°3' North of the equator and longitude 7°42' East of the Greenwich meridian. Zaria comprises two local government areas, Zaria and Sabon Gari. Zaria is made up of a natural and stable ecosystem in the northern Guinea Savannah zone, with a discontinuous layer of sparsely distributed short trees followed by relatively continuous layers of tall, medium, and short grasses with a mean annual rainfall below 125mm (Mortimore, 1970).

### **Sample Collection**

A total of one thousand (1000) date palm fruits sold in open markets were purchased between October 2016 and March 2017 from randomly selected open markets around Zaria including Samaru, Sabon Gari, Tudun Wada, Zaria city, and Dan Magaji markets. Two hundred (200) fruits were collected from each market at three selling points.

### Visual observation of insect pest damage

The fruits were assessed by visual observation after manual dissection of the fruits to check for the incidence of the larva, pupae, frass, or cocoon. Any existing insect stage(s) or infestation symptoms were identified on-site as much as possible, recorded and categorized as described by Lale (2001) into 0 = unattacked, 1 = light feeding, 2 = moderate feeding + frass (excretes) and 3 = extensive or high feeding + frass + cocoon and pupal casing. With respect to this study, 0 and 1 = Normal fruits, 2 = Defective, 3 = highly defective

### Collection and identification of insect pests of date palm

The date fruits were sorted and infested fruits were taken to the Entomology Laboratory, Department of Crop Protection, A.B.U., Zaria. Each of the infested date fruits was screened for insects' infestation by opening with forceps. The adult insects were collected and placed in transparent plastic containers and were placed in a freezer for humane killing followed by identification of the insects. The pupae were placed in containers and kept in a cage at room temperature.

### Insects rearing

The larvae were separated from infested fruits and subjected to rearing by preparing the feed, introducing the larvae to the feed, and placing them in the larval room under controlled temperature and relative humidity of 25°C and 83 respectively for the rearing process. They were reared in transparent plastic jars (30 × 20 × 13 cm) and artificial diet (containing wheat flour 72g, honey 12g, yeast 1g, distilled water 500ml, wheat germ 10g, Agar 7.4g, Aureomycine 0.45g, Vitamin suspension 3.5ml, potassium hydroxide 2ml, Acetic acid 5ml, Formaldehyde 2ml, choline chloride 3.2 mL) in controlled condition (25 ± 2 °C, 83 ± 5% RH). The emerged adults from infested fruits were transferred into transparent jars (18 × 7 cm) and were provided with cotton wool soaked in 10% honey for feeding, before identification (insectrearing.com).

### Data Analysis

The prevalence of insect infestation on date palm fruits was expressed in percentage as:

$$\text{Prevalence of infestation} = \frac{\text{Number of infested fruits}}{\text{Total number of sampled fruits}} \times 100$$

## RESULTS

### Visual observation of insect pests' damage

Damage assessment of dried date palm fruits by visual observation after manual dissection of the fruits sampled from the markets for the incidence of insect pests and developmental stages are presented in Plate I.

### Order and distribution of the insect pests

The frequently seen pests affecting date fruits are of different species of the orders Coleoptera and Lepidoptera. The order Coleoptera are commonly called Beetles and are a diverse group of insects characterized by adults with hardened wings and three pairs of legs. The pest destructive stages are the adults and larvae that feed on the flesh of the fruit, especially those contaminated by fungi and yeasts. Damage is thus reflected in reduced yield and quality. The order Lepidoptera are the moths and butterflies and are cosmopolitan. The mouthparts are vestigial or form a tubular proboscis and chewing mouthparts. The larvae of these insects are probably more destructive to crops and forest trees (Table 1). In all the markets visited, insect infestation caused greater damage to date fruits particularly in Sabon Gari, Zaria city, and Samaru where *Oryzaephilus surinamensis*, *Carpophilus hemipterus*, *Lexostege nudalis*, and *Aphthona whitefieldi* were found to be the major

pests of the date fruits in these areas. While in Dan Magaji and Tudun Wada the predominant pests were *Dinoderus* species, *Oryzaephilus surinamensis* and *Tribolium confusum* (Table 1).

### **Level of defects in date fruits**

Sabon Gari had the highest mean value of normal fruits (150.00), followed by Tudun Wada (145.33). Dan Magaji and Zaria city had 120.67 and 117.00 respectively, while Samaru had the lowest mean value (115.66) of normal fruits (Table 2). Under the category of infested fruits, Tudun Wada had 50.00, Dan Magaji had 74.33, Zaria city had 83.00 and Sabon Gari had the lowest value of 48.00. Whereas, Samaru is highly defective with a mean value of 84.33. Also, there is no significant difference between the sampling areas (Table 2).

Figure 1 presents information on the mean count of the date fruits concerning the level of damage across the different sampling areas. This shows the distribution of the fruits in the sampling areas, into three categories; Normal, defective, highly defective fruits after visual observation (Figure 1).

### **Prevalence of infestation in date fruits**

The insect with the highest prevalence (47.4%) was *Oryzaephilus surinamensis* while *Aphthona whitefieldi* had the lowest prevalence (5.3%) and probably a new record of insect pests in date palm. *Oryzaephilus surinamensis* is the only insect pest found in all the sampling locations. While *Aphthona whitefieldi* was only found in Sabon Gari market and Zaria City (Table 3).

### **Discussion**

Infestation and damage by insects feeding on the dates are one of the primary causes of post harvest losses in quality and quantity of several stored products. Dates used in this study were infested with some stored-products insects such as *Oryzaephilus surinamensis*, *Carpophilus hemipterus*, *Tribolium confusum*, *Dinoderus* species, and *Aphthona whitefieldi* and *Lexostege nudalis*, and are mainly Coleopterans and Lepidopterans. Aisagbonhi *et al.* (1997) reported that dry date palm fruits are commonly attacked by more than 12 insect species belonging to the orders Coleoptera and Lepidoptera. Major insect pests that were associated with stored dried fruits in the dry savanna zone of Nigeria include confused flour beetle *Tribolium castaneum*, *Cryptolestes ferugineus*, *Tenebroides mauritanicus*, *Trogoderma granarium*, *Stegobium paniceum*, *Araecerus fasciculatus*, *Ptinustectus*, *Lasioderma serricornis*, *Ephestia elutella*, *Plodia interpunctella*, *Tyroglyphus farinae*, *Sitophilus* Sp. (Lale, 2002; Walter, 2002; Williams *et al.*, 2002).

Interestingly, *Aphthona whitefieldi* (Coleoptera) is the newly identified insect of dried date palm fruits in this study. A sift through the literature on the insect pest of stored dates did not reveal any information on *A. whitefieldi* as a pest of date fruits. *Aphthona whitefieldi* may be considered as a new pest of date fruits and its presence in date appears disturbing. The transboundary trade-in date fruits are high, and there is hardly any organization that checks the movement of these fruits into the Nigerian territory. Related species of *Aphthona* were reported to be used as biological control agents of leafy spurge have been used as an alternative to chemicals in Europe and the USA (Lym, 1998; Anderson *et al.*, 2000).

According to Porter *et al.* (1991), climatic variations may bring changes in geographical distribution, crop-pest synchrony, inter-specific interactions, increased over-wintering, elongation of development periods, increasing number of generations, and increased chances of invasive pest species episodes. Furthermore, Cannon (2004) reported that as temperatures increase, insects become more abundant through various inter-related processes, such as phenological changes and range extensions, as well as population growth,

development, over-wintering, migration, and possibly wind dispersal. As such, this may be one of the principal reasons for finding *A. whitefieldi* in date palm fruits.

*Oryzaephilus surinamensis* are the insects with a high incidence of occurrence in this study. The saw-toothed grain beetle is found in flour, grains, seeds, and many kinds of stored products (Fasulo *et al.*, 2005). Sawtooth beetle (*Oryzaephilus surinamensis* L.) attacks date palm fruit in the store, thereby reducing its market value. The insect (adult stage and larvae stages) eats the date by digging tunnels between the peel and the content. Date of low wet content and those with wounds and cracks are mostly infected by this insect (Al-Hafidh *et al.*, 1987).

In this study, most of the date palm fruits observed were damaged above the level accepted for sale in the markets. Incidence of damage is common amongst all the markets, and this may be attributed to use similar storage conditions, that is, in jute or polyester bags. Sabon Gari has the highest value of normal fruits (82.00%) and considered to be the healthiest. This is followed by Tudun Wada (71.00%) and Zaria City (71.00%). Samaru had 68.33% while Dan Magaji had the lowest value (52.33%) of normal fruits. For instance, infested and defective fruits are prevalent in Tudun Wada (79.00%), Dan Magaji(68.33%), Sabon Gari (63.33%), and Zaria city (45.33%).

In this study, the larval, pupae, and adult stages of the insects *Oryzaephilus surinamensis*, *Carpophilus hemipterus*, *Tribolium confusum*, *Dinoderus* species, *Aphthona whitefieldi*, and *Lexostege nudalis* were found infesting date fruits in the study area.

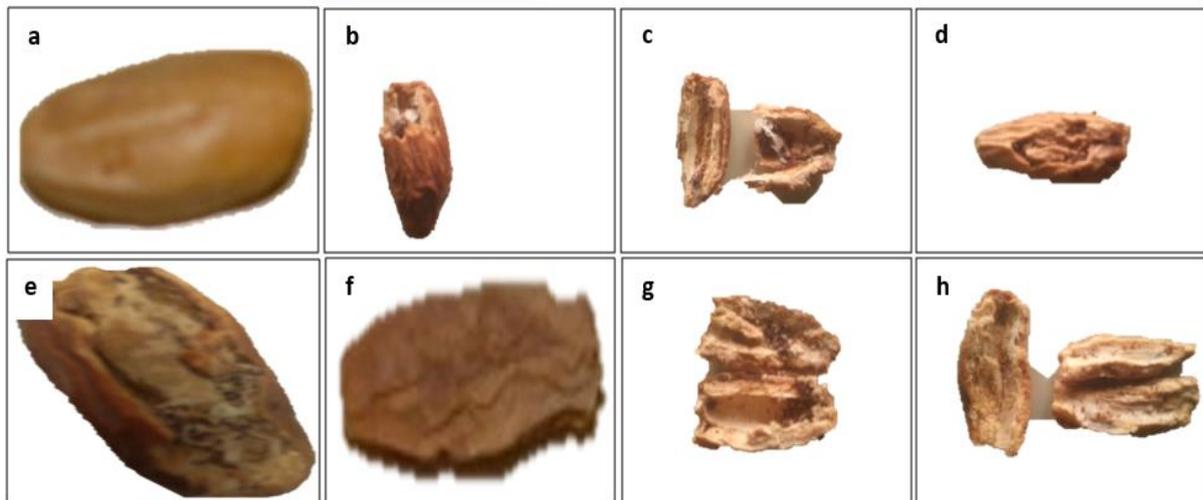
## CONCLUSION

This study concludes that any date fruit with a hole is likely to contain infesting adult insects or their larvae which may harbour pathogenic organisms. *Aphthona whitefieldi* (Coleoptera) is the newly identified insect of dried date palm fruits in this study. Hence, there is a need for proper education concerning the storage of date palm fruits to reduce contamination and infestation by insects.

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**Plate I(a-g):** Pictorial presentation of healthy and defective forms of selected date palm fruit **a)** A healthy and normal date palm fruit with smooth skin (Sabon Gari market), **b)** a defective and broken date palm fruit with hole and pupal casing (Zaria city market), **c)** defective with infestations with larvae, pupae and frass (Zaria city market), **d)** deformed, discoloured, spotted and broken (Sabon Gari market), **e)** broken and woody (Dan Magaji market), **f)** shriveled, light and deformed (Tudun Wada market), **g)** infestations with larvae and frass (Tudun Wada market), and **h)** broken and infested with frass (Samaru market).

**Insect pests of dried date palm (*Phoenix dactylifera* L.) fruits sold in selected markets in Zaria, Kaduna state, Nigeria**

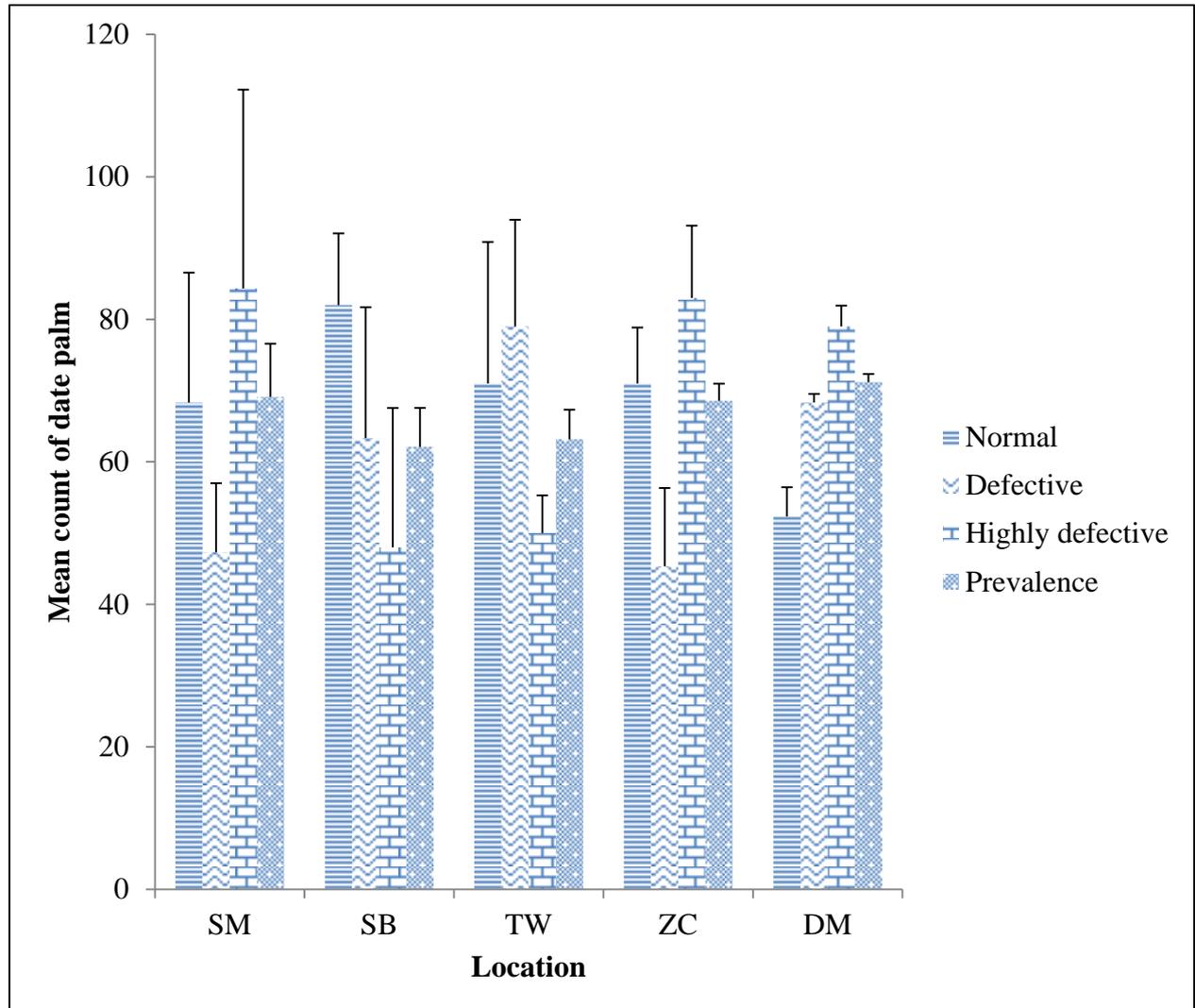
**Table 2:** Distribution of insect pest infesting date palm fruits collected from selected markets in Zaria, Kaduna state, Nigeria

Insects	Common name	Order	Family	Destructive stage	Distribution				
					Samaru	Sabongari	Tudunwada	Zaria city	Danmagaji
<i>Apthona whitefieldi</i>	Beetle	Coleoptera	Chrysomelidae	Adult and larvae	-	+	-	+	-
<i>Carpophilus hemipterus</i>	Beetle	Coleoptera	Nitidulidae	Adult and larvae	+	+	-	+	-
<i>Oryzaephilus surinamensis</i>	Beetle	Coleoptera	Silvanidae	Adult and larvae	+	+	+	+	+
<i>Tribolium confusum</i>	Beetle	Coleoptera	Tenebrionidae	Adult and larvae	-	-	+	-	+
<i>Dinoderus</i> sp.	Beetle	Coleoptera	Bostrychidae	Adult and larvae	-	-	+	-	+
<i>Loxostege nudalis</i>	Moth	Lepidoptera	Pyralidae	Larvae	+	+	-	+	-

\*+ = presence, \*- = absence

**Table 3:** Level of physical defects of date palm fruits collected from selected markets in Zaria, Kaduna state, Nigeria

Sample	Non-infested fruits (mean value)	Infested fruits (mean value)	Prevalence (%)
Samaru	115.66	84.33	42.16
Sabongari	150.00	48.00	27.33
Tudunwada	145.33	50.00	25.00
Zaria City	117.00	83.00	41.50
Danmagaji	120.67	74.33	39.66

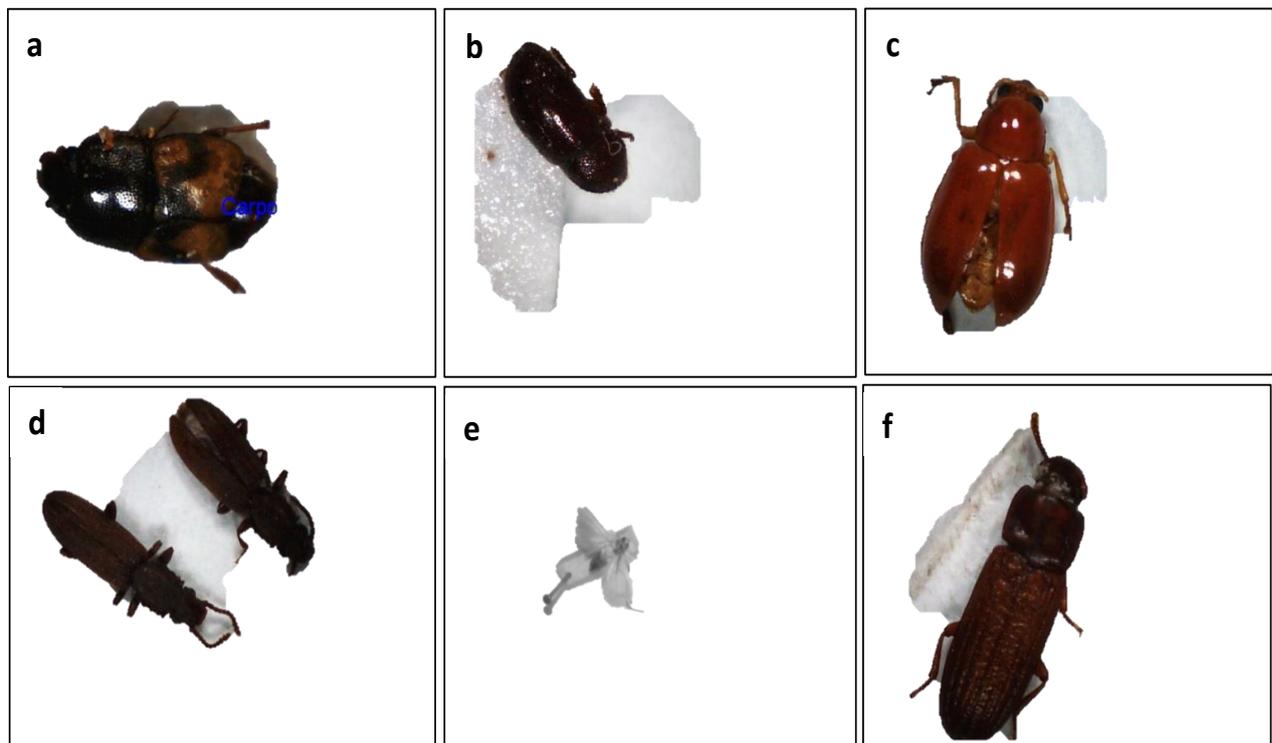


**Figure 1:** Incidence of insect pest infesting date palm fruits collected from selected markets in Zaria, Kaduna state, Nigeria. **Key:** SM (Samaru market), SB (Sabon Gari), TW (Tudun Wada), ZC (Zaria city) and DM (Dan Magaji)

**Insect pests of dried date palm (*Phoenix dactylifera* L.) fruits sold in selected markets in Zaria, Kaduna state, Nigeria**

**Table 4:** Prevalence and mean intensity of insect pest infesting date palm fruits collected from selected markets in Zaria, Kaduna state, Nigeria

Insects	Prevalence (%)	Mean intensity
<i>Oryzaephilus surinamensis</i>	47.4	0.47
<i>Tribolium confusum</i>	21.1	0.21
<i>Dinoderus</i> spp.	7.9	0.08
<i>Aphthona whitefieldi</i>	5.3	0.05
<i>Lexostege nudalis</i>	10.5	0.11
<i>Carpophilus hemipterus</i>	7.9	0.08



**Plate II (a-f):** Adult stages of insect pest infesting date palm fruits collected from selected markets in Zaria, Kaduna state, Nigeria a) *Carpophilus hemipterus* b) *Dinoderus* Sp, c) *Aphthona whitefieldi* d) *Oryzaephilus surinamensis* e) *Lexostege nudalis* f) *Tribolium confusum*