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A Comparative Study of Weevil Infestation in Different Species of Beans Sold at Selected Market in Awka, Anambra State Southeast Nigeria

Emmanuel Okwudili Ogbuefi, Uzochukwu Chukwuebuka Uzochukwu, Chigozie Onyeka Chukwudike, Ikechukwu Isaac Okechi

Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University Awka, Anambra State, Nigeria

Corresponding Author:** ***Emmanuel Okwudili Ogbuefi, *Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University Awka, Anambra State, Nigeria*

Abstract: *The research was conducted to identify weevil species, determine the effect of weevil infestation on some qualities of beans such as;Total Dietary Fibre (TDF), Total Protein (TP)and Total Carbohydrates (TC)in different species of beans sold at Eke Market, Awka Anambra State Southeast Nigeria between July-September, 2022. Experimental study design was used and the results of the study showed that only one species of weevil (Acanthoscelides obtectus) was found to infest the three species of beans used: Iron beans, Patasco beans and Brown beans. The effect of infestation varied across the different species of beans. There was increase in the fibre content of infested iron and patasco beans but decrease in the fibre content of infested brown beans. There was also an increase in protein content of all the species of beans, while in carbohydrate content, there was increase in infested brown andiron beans, and decrease in infested patasco beans although there was no statistical significance in the percentage Fibre content (F=1.45, df=5, p>0.05), Carbohydrates content (F=0.75, df=5 p=>0.05), and protein (F=1.45, df=5, P>0.05).Farmers and pest managers must make deliberate effort to prevent weevil infestation as this can reduce the nutritional content of beans drastically. It is also important to store beans properly and inspect them regularly for early signs of weevil infestation to prevent these negative debilitating effects.*

Keywords: *Abundance, beans, weevil, Awka, Anambra State, Nigeria*

1. INTRODUCTION

Bean is a main leguminous culture in the vegetable crops production which is attacked by a great number of pests, amongst them is the bean weevil *(Acanthoscelides obtectus* Say) which causes serious problems in grain storage. This weevil eats the inner content and contaminates the beans with excrements of the larva which makes seed flavour and sowing seed properties worse, as well as decreases the seed weights and viability (Kyamanywa, 1990). Unfortunately, beans is prone to heavy field and postharvest infestation damage and this constitutes one of the major constraints to its optimal utilization as food as well as limits its contribution to food security (Kungu *et al.*, 2003). Beans are further severely damaged in the store by the foremost beans storage pest, the bean weevil *Callosobruchusmaculatus,* which borehole into the seeds resulting in loss of food grain and quality.

The losses incurred by this weevil to beans in storage is reported to reach 100% sometimes, if left unattended, compelling many farmers in Africa, Asia and Southern America to dispose of their crops soon after harvest thus reducing an important protein and income source for their families (Sanon *et al.*, 2010; Ajayi*et al.*, 2015; Oyeniyi *et al.*, 2015). Significant losses in seed weight, viability, protein content, essential amino acids, total fat, mineral matter, vitamins, soluble sugars, starch digestibility, emulsification, foam and viscosity properties and increase in free fatty acids and peroxides of insect-infested grains has been extensively reported (Odejayi, *et al.*, 2014; Ojimelukwe *et al.*, 1999 and Sallam, 2008). Jood *et al.*, (1993) also reported deleterious effects on protein quality (such as biological value, net protein quality (such as biological value, net growth performance of study rats fed insect infested sorghum grains. The activity of insect pests in stored grains was also found to leave behind sloughs, frass and other secretions and to raise the products temperature and humidity which all predispose the grains to bacterial and fungi contamination especially aflatoxin poisoning, suggesting the potential danger infested beans can pose to the consumer in addition to losses in nutrients, functional properties and unpleasant sensory qualities (Carlos, 2004; Sallam, 2008; Odejayi, *et al*., 2014; Odejayi and Aina, 2016). It is still common place to find both moderately to severely infested beans in Nigerian markets as consumers tend to ignore the consequences of infestation on the nutrient quality if the physical appearance, organoleptic and/or functional properties have not deteriorated appreciably (Ojimelukwe *et al*., 1999).Weevil infestations may be difficult to detect in homes, until you find the young adults flying around your home, gathered by the hundreds on windowsills or crawling on your walls. A likely place to determine the source and growth potential for a bean weevil infestation lies in stored whole beans in the pantry. Seeds in which development by *Callosobruchusmaculatus* is slow also produce smaller adult weevils than those in which development is more rapid under similar conditions of temperature and humidity(Larson *et al*., 2003*).* Lipman(2006),referring to *Acanthoscelides obtectus* , says that a decrease in atmospheric moisture lengthens the life cycle of larva, shortens the life of the adult, and prevents the young larvae from entering the beans. Riley in 1882, was the first to report continuous breeding in stored beans with successive generations of *Acanthoscelides obtectus.* In public warehouses the principal sources of infestation are lots of unfumigated beans thought to be in perfect condition, lots of beans known to be weevil infested for which there is no sale, rain-damaged beans, bean screenings, and spilt beans (Larson *et al*., 2005). Beans in the cracks of the floor and in the bean cleaners may also become important sources of infestation. On the farm the main sources of infestation are left-over seed beans, or a few pounds of beans left in the bean planter, and beans that remain in the bean straw, together with small lots of beans kept or purchased for home use (Larson *et al*., 2005).

Many researches had earlier been carried out on beans and generally compared infested beans with un-infested beans yet there is paucity of information on the effect of infestation on the qualities such as Total Dietary Fiber (TDF) and Blue Value Index (BVI) of beans and there different degrees of acceptability and usefulness of the infested beans at different levels of infestation. This research is therefore to identify weevil infestations in different species of beans sold at Eke Awkamarket, Awka, Anambra State Southeast Nigeria and find out its effects on the afore listed qualities.

2. MATERIALS AND METHODS

2.1. Study Area

Samples for this study was collected from Eke Awka Market, Anambra State while the laboratory examination was carried out in the laboratory of Applied Biochemistry Department, Nnamdi Azikiwe University, Awka, Anambra State. The study area is located between Latitude 6.245^{o} to 6.283^{o}N and Longitude 7.115^{o} to 7.121^{o}E. The temperature in Awka is generally 27-30^{o}C between June and December but rises to 32-34^{o}C between January and April with the last few months of the dry season marked by the intense heat. Awka has a rainfall pattern ranging from 1828-2002mm whereas the climate falls within the tropic wet and dry type based on Koppen's classification (Ezenwaji *et al*., 2013).

2.2. Study Design and Collection of Samples

The study design used was an experimental study design. Three different species of Beans: Brown beans, Iron beans and Patasco purchased from Eke Awka market Awka, Anambra State were randomly sampled between July-September, 2022. On purchase from the market, infested seeds were sorted from the un-infested ones and the pests were taken to the laboratory section of the Department of Parasitology and Entomology, Nnamdi Azikiwe University for identification.

2.3. Preparation of Samples

Five (5) grams of each infested samples were examined for presence weevils which were handpicked and placed in a Petri dish before identification. Also, all samples both infested and uninfested was winnowed and milled into flour using mortar and pestle. The samples were packaged in low density polyethylene wraps and stored in an air-tight container in preparation for further analysis.

2.4. Identification of Weevils

Using a Dissecting microscope, the weevils were identified using the morphological characteristics described by Luke *et al.*, (2020) by the help of the laboratory technologist in the Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Nigeria.

2.5. Total Dietary Fibre Determination

The Total Dietary Fiber (TDF) was determined using the gravimetric methods of (Association of Analytical Chemists [AOAC], 1999). The dietary fiber method gives an estimation of insoluble and indigestible food residue which remains after which the sample has been treated under prescribed conditions. It was determined by consecutive treatment with light petroleum, boiling dilute sulphuric acid, boiling dilute NaOH, dilute HCl, alcohol and ether. The insoluble residue was collected by filtration, dried, weighed and ashed to collect mineral contamination.

Research Procedure: The defatted sample obtained using Soxhlet apparatus (using hexane as solvent) was air dried and transferred into a 250ml conical flask. 200ml of 1.25% sulphuric acid was added and heated gently for 30 minutes. The flask was rotated every few minutes, in order to mix the content and remove particles from the side. At the end of the 30 minutes boiling period, the acid mixture was allowed to stand for one minute and then filtered using a filter paper. The filtration was so fast and was completed within 2minutes. The insoluble matter was washed with boiling distilled water until the filtrates is free from acid. The insoluble matter was washed back into the flask by means of wash bottle containing 1.25% NaOH and boiled for 30 minutes with the same precaution as those used in the early acid treatment. At the end of the 30minutes boiling, the mixture was allowed to stand for one minute and then filtered immediately using a filter paper. The insoluble matter was wash with boiling water until no base is detected in the filtrate. The whole insoluble matter was washed with 1% HCl and finally with boiling water until free from acid, it was then washed twice with alcohol and three times with ether. The insoluble matter was transferred into a dried weighed crucible and then oven-dried at 100^{o}C to constant weight. The crucible and its content was ash in muffle furnace at 550^{o}C and re-weighed. The difference between the weight of ash and the weight of insoluble matter gave the weight of the dietary fiber. The % total dietary fiber was calculated thus:

$$\% \text{ Total Dietary Fiber} = \frac{Weig\,htofdriedinsolublematter \quad - weig\,htofas\,h}{weig\,htofsamplebeforedefatting} \text{ x } 100$$

3. Total Protein Determination Using the Biuret Method

Research Procedure: 1g of homogenized sample was soaked in 10ml of distilled water for about 3 hours. This was then centrifuged at 3500rpm for 30 minutes and the supernatant was used for the assay. Two test tubes were labeled standard and sample. To these test tubes, 1ml of a standard protein (Bovine serum albumin) and supernatant were added. This was followed by addition of 5ml of Biuret reagent and the absorbance was measured against a reagent blank after 20 minutes (Race, 1932). The total protein was calculated thus:

$$\% \text{ Total Protein} = \frac{Abs\,orbanceofsample}{Absorbanceofstandard} \times Concentrationofstandard$$

4. Total Carbohydrate Determination Using the Phenol Sulfuric Acid Method

4.1. Research Procedure

One gram of homogenized sample was soaked in 10 ml of distilled water for about 3 hours. This was then centrifuged at 3500rpm for 30 minutes and the supernatant was used for the assay. To some prewashed test tubes, 0.25ml of the supernatant was added. This was followed by addition of 0.25ml of 5% phenol reagent and 2.5ml of sulfuric acid. The absorbance was read at 470nm against a reagent blank after which the concentration was determined from a standard glucose curve and reported in mg/g of sample (Dubois *et al*., 1956).

4.2. Analysis of Data

The data obtained from the study was summarized using tables and computed into Means ± Standard Deviation (SD). Analysis of variance (ANOVA) was used to detect any significant difference due to insect infestation. Where significant differences existed, Fishers Least Significant Difference (F-LSD) was used to separate the means. Significant difference in sample means was accepted at p <0.05.

5. RESULTS

5.1. Plates of Uninfested and Infested Beans Samples Sold at Eke Awka Market, Awka

Plate1. *Uninfested Iron Beans*

Plate2. *Uninfested Pataso Beans*

Plate3. *Unifested Brown Beans*

Plate4. *Infested Iron Beans*

Plate5. *Infested Brown Bean*

5.2. Identification of Weevil Species in the Different Species of Beans

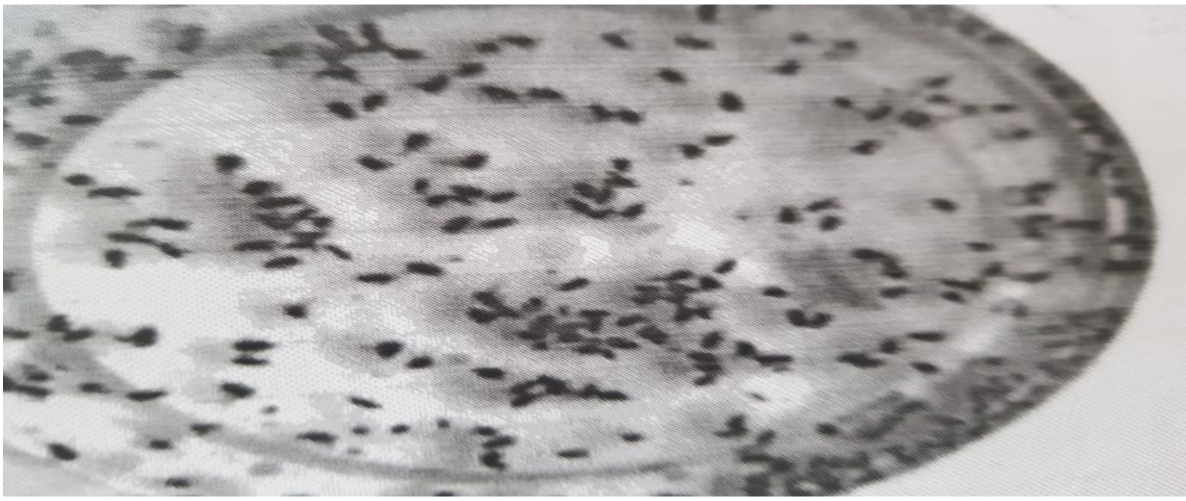

Plate6. *Bean Infestation with Acanthoscelides obtectus*

5.3. Determination of the Effect of Weevil Infestation on the Total Protein (TP), Total Carbohydrates (TC) and Total Dietary Fibre (TDF) of the Infested Beans Samples Examined

Table 1 shows the effect of Weevil infestation on the Total Protein (TP), Total Carbohydrates (TC) and Total Dietary Fibre (TDF) of the infested beans samples examined. The Infested beans irrespective of their species had low nutritional values than uninfested beans. When compared using one-way ANOVA, there was no statistical significance in the percentage Fibre content (F=1.45,df=5, *p*>0.05), Carbohydrate content (F=0.75, df=5, p>0.05), and Protein content(F=1.45,df=5,p>0.05).

Table1. *Effect of weevil infestation on some nutritional qualities of the beans samples sold at Eke Awka Market, Awka Anambra State*

	Fibre (TDF) (Mean±SD)	**Protein (TP)** (Mean±SD)	**Carbohydrate (TC)** (Mean±SD)
Infested Brown beans	0.80±0.28	0.14±0.03	32.62±0.88
Uninfested Brown beans	1.10±0.14	0.17±3.55E	32.60±0.79
Infested Iron beans	1.00±0.28	2.14±0.03	33.53±0.16
Uninfested Iron beans	0.80±0.28	0.13±0.09	32.90±0.74
Infested Patascobeans	1.48±0.85	0.17±0.01	33.04±0.14
Uninfested Patascobeans	1.20±1.13	0.11±3.53	32.30±0.96
Total: *P*- value	0.328	0.329	0.617

Values are mean of two independent determinations. (P> 0.05)

6. Discussion

A comparative effect of weevil infestation on the nutrients of beans sampled was studied and the results of species identification showed that only one species, *Acanthoscelides obtectus* was found in all species of the infested beans examined. This agrees with Nta*et al*., (2019) who identified and described *A. obtectus* as a destructive post-harvest pest of beans in their study. The destructions caused by this beans weevil are of economic and nutritional importance. Although the result had no statistical significance between beans species analyzed for their Protein, Carbohydrate and Dietary fibre content but Nta *et al*., (2019) documented a significant (p = 0.05) reduction in protein, fibre and carbohydrate content of *P. vulgaris* and *P. acutifolius* from their proximate analysis.

In Fibre content, the effect of infestation was 0.80±0.28, 0.80±0.28, and 1.48±0.85 for Infested Brown Beans, Infested Iron Beans and Infested Patasco respectively. Although the effect varies across the different samples of beans, there was no statistical significant different between each. However, for the uninfested beans samples, the fiber content was 1.10±0.14, 0.80±0.28 and 1.20±1.13, for Infested Brown Beans, infested Iron Beans and infested Patasco respectively. Between the infested and uninfested beans samples, they showed no statistical difference in their fiber content (p = 0.328). This finding disagrees with that of Nta *et al*., (2019) who recorded a decrease in fiber content. Usually, the reduction in these proximate nutrients due to *A. obtectus* infestation reduces the medicinal value of these legumes. Adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer (Milavec *et al*., 2001). The increase in fiber content recording in this study for infested Iron Beans and infested Patasco may possiblybe as a result that weevils do not break down insoluble fibres like cellulose and lignin, therefore the overall fibre content of the beans may not change significantly. The effect of infestation on carbohydrate Iron, Brown and Patasco beans was 33.53±0.16, 32.62 ±0.88 and33.0±0.14 respectively. The results was in disagreement with El-Dessouki *et al* (1984) who reported a decrease in total carbohydrate in infestation of cowpea seed with *C. maculatus* to reach 64.5 ±0.28 and 60.0 ±0.17, also in protein content, the effect of infestation was 0.14±0.03, 2.14±0.03 and 0.17±0.01 for infested brown beans, infested Iron Beans and infested Patasco respectively. This disagrees with Ojimelukwe *et al.,* (1999), who reported depletion in protein content of infested samples attributed to utilization of the protein nutrient by the insects. Ojimelukwe *et al.* (1999) reported a decrease of 19% and 28% in protein content of Kano white and Ife brown varieties, respectively which disagreed with 0.14±0.03,2.14±0.03 and 0.17±0.01increase in protein content observed in this study. The increase in mean protein content of infested beans cannot be a true increase in protein content. Jood *et al.,* (1993) noted that no matter the direction of change in the nitrogen content of infested grains, the true protein content of such grains decrease and the real nutritional value of protein is not reflected in chemical analysis of infested cowpeas because of a number of factors like presence of insect excreta and body fragments among others. Invariably, biological evaluation of protein quality is most desirable in such situation according to Jood *et al.* (1993).

7. Conclusion

This study had shown that only one species of weevil, *Acanthoscelides obtectus*, was found to infest the three species of beans used in the research. Weevil infestations have many effects on the nutritional content of beans like protein, carbohydrate and fibre. The loss in protein and carbohydrate content reduces the nutritional values of the beans making it less beneficial for human consumption, though, at low infestation the beans still have nutritional values. However, farmers and pest managers must make effort to prevent infestation, especially heavy infestation, as this can reduce the nutritional content of beans drastically. It is also important to store beans properly and inspect them regularly for early signs of weevil infestation to prevent these negative debilitating effects as observed from this study.

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