

Effect of Insect Infestation on Quality Parameters of Wheat

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Abstract. The effects of insect infestation by *Rhizopertha dominica* on quality parameters of wheat (UP2204) were investigated. The wheat samples (uninfested and infested) were analyzed for nutritional contents viz.–Carbohydrate, Protein, Phenol and the changes in chemical structure were assessed by SEM. Chemical analysis showed that due to infestation carbohydrate and protein content decreased by 85.7% and 13.5% respectively whereas total phenol content increased relatively by 41.6% due to difference in distribution of protein and carbohydrates throughout the wheat grains and the Carbon, Phosphorous, and Potassium contents spiraled up by 4%, 2% and 1% respectively. Infestation also led to weight loss of 16.7% and changes in the chemical structure and composition of wheat grain.

Keywords: Wheat, insect infestation, *R.dominica*

1. Introduction

Wheat is an important dietary component through various types of products, world over. It proves to be good source of carbohydrates, B vitamins and some minerals in vegetarian diets of majority of population of Asia and Africa. It is vulnerable to attack by several insects like *Rhizopertha dominica*, *Trogoderma granarium*, *Sitophilus oryzae* etc. during storage. Of these *Rhizopertha dominica* Fabricius (Coleoptera Bostrichidae), commonly called as lesser grain borer is a very notorious pest of cereals mainly wheat, rice and sorghum. It is highly polyphagous and present throughout warmer regions of the world [1]. During high levels of infestation, it devours the entire kernel and reduces the grain to thin skins. However, *Rhizopertha dominica* is not known to attack the standing crop but due to its potent flight ability, it can easily migrate from one granary to the other creating a menace.

Insect-pest infestation has been reported to hamper the protein quality of cereals by increasing uric acid level, creating unhygienic conditions by addition of insect fragments, reducing carbohydrate thereby making it unfit for consumption. [2]. On the other hand, when content of antinutrients like polyphenols and phytic acid were investigated, they exhibited an increasing trend.

Thus, stored grain pests are deleterious to human health as they damage the grains and hence, deteriorate their nutritive value. In a way infested grains are deficient food i.e. incapable of carrying out the vital roles in the body metabolism.

2. Materials and Methods

2.1. Sample Collection and Processing for Analysis

Uninfested and infested samples of wheat (UP2204) by *R.dominica* were procured from Grain Mandi, New Delhi, India. Grains were cleaned and grinded to form fine powder and then stored in air tight plastic zip bags for chemical analysis. The samples were analyzed in triplicates.

2.2. Weight Loss

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It was determined by comparing weight by volume ratio of infested grain sample against control-uninfested wheat sample. 10 grains were chosen randomly from uninfested and infested wheat samples and were weighed. These grains were added to 50 ml of water in a measuring cylinder which lead to a change in volume. The weight of grains over the volume change represents the weight loss i.e. expressed in %.

2.3. Reducing Sugars

Reducing sugars were determined in uninfested and infested wheat flour by employing DNS Method. The underlying principle is that reducing sugars present in wheat reduce 3,5-dinitrosalicylic acid (DNS) to 3 amino 5 nitro salicylic acid which absorbs light strongly at 540nm [3]. The amount of reducing sugar in the samples was calculated using a standard graph prepared from working standard of glucose solution (0 to 500 µg/ml).

2.4. Protein

Protein content was determined by Bradford method i.e. a colorimetric protein assay, based on an absorbance shift of the dye Coomassie Brilliant Blue G-250 in which under acidic conditions the red form of the dye is converted into its bluer form at 595nm, to bind to the protein being assayed [4]. The standard curve was prepared by dissolving 25mg of bovine serum albumin in 0.15 NaCl and the volume was made upto 25ml (1mg/ml).

2.5. Phenol

Total phenols were determined by Folin Ciocalteu reagent [5] of measuring the absorbance at 765 nm. The standard curve was prepared using 0, 50, 100, 150, 200, 250 mg/L solutions of gallic acid in methanol: water mixture (50:50, v/v). Total phenol values are expressed in terms of gallic acid equivalent (µg/g of dry mass).

2.6. Energy-dispersive X-ray Spectroscopy (EDX) Analysis

The technique was used for elemental analysis of uninfested and infested wheat flour. It was performed by Bruker-AXS Energy Dispersive X-ray System (Model QuanTax 200). Dried sample powder (infested and uninfested wheat flour) was used as a specimen that was metal coated in gold to avoid sample charging and to improve secondary electron signal strength.

2.7. Scanning Electron Microscopy Analysis

SEM study was done to obtain the topographical characterization of infested and uninfested wheat sample. Dried wheat grain, (from uninfested and infested slots) was used as a specimen for the analysis. SEM measurements were performed with ZEISS EVO Series.

3. Results and Discussion

It was observed that due to feeding of pest on wheat grains lead to 16.79% weight loss. There was a stupendous decrease of 85.7% in reducing sugars of infested wheat as sugars are mainly confined to endosperm of the seed i.e. exclusively attacked by *R.dominica*. It was noted that even protein content exhibited a downfall (13.5%) but the effect was less pronounced as compared to reducing sugars in infested wheat owing to difference in distribution of protein and carbohydrates throughout the wheat grains. On the contrary total phenols were found to be relatively increased as *Rhizopertha dominica* feeds exclusively on endosperm of wheat making the grain hollow devoid of the content of the grains sparing the testa layer which is reported to contain polyphenols. High level of polyphenols restricts the bioavailability of macroelements. EDX analysis revealed that carbon, phosphorous, potassium were increased by 4%, 2%, 1% respectively (Table 1). This increase can be attributed to the fact that insects contribute to macroelements by their excrement and exuviae [6].

SEM pictures were obtained at magnification 2000X and it revealed that uninfested wheat, starch granules are distinctly visible (Fig. 1) whereas in infested wheat, starch granules are nibbled off leaving aleurone cell layers smooth (Fig. 2). This further elucidates that *R. Dominica* feeds majorly on starch.

4. Conclusion

It may be inferred from the present investigation that insect infestation causes weight loss and significant reduction in reducing sugars, proteins whereas phenol content and macroelements (C, P and K) spiral up. SEM analysis showed that exclusively starch globules are nibbled off by the pest.

Table 1: Effect of Insect Infestation on Quality Parameters of Wheat

S.No.	Parameter	Uninfested wheat	Infested wheat	Remarks
1.	Weight loss	-	16.79%	-
2.	Reducing sugars	1.26 µg/g	.18 µg/g	Reducing sugars decreased by 85.7%.
3.	Protein	105.5 µg/mg	91.2 µg/mg	protein decreased by 13.5 %
4.	Phenol	99.265 µg/g	140.6 µg/g	Phenol content increased by 41.6%.
5.	Carbon	35.34%	40.59%	Carbon content increased by 4%,
6.	Phosphorous	.23%	.78%	Phosphorous content increased by 2%,
7.	Potassium	.13%	.51%	Potassium content increased by 1%

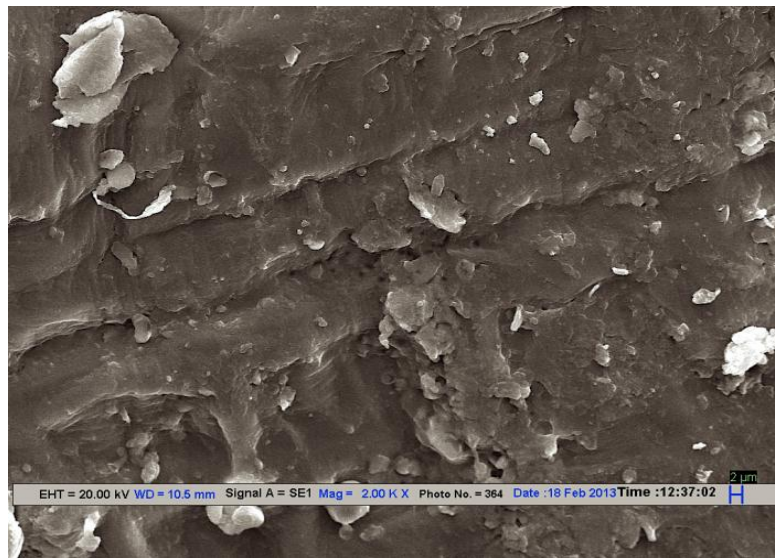


Fig. 1: SEM micrograph of uninfested wheat

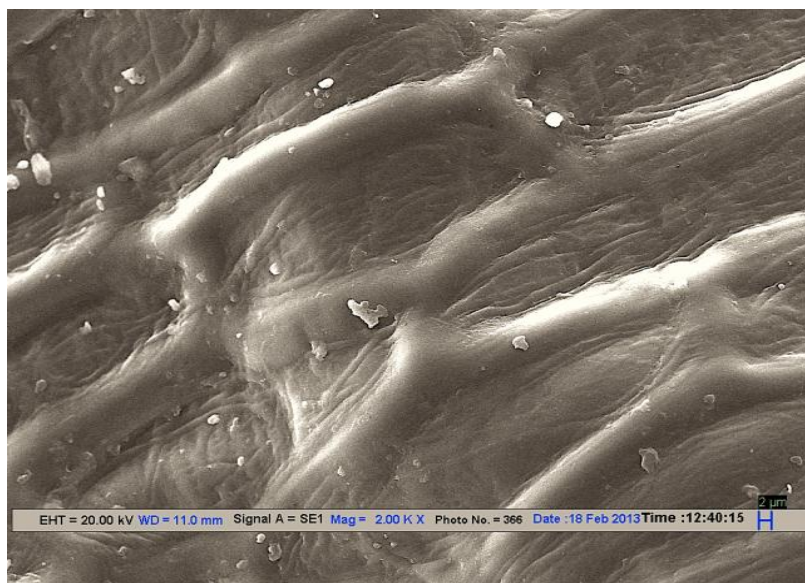


Fig. 2 : SEM micrograph of infested wheat

These findings highlight that efforts should be intensified to develop suitable engineering design of grain storage structure along with scientific pest control measures by employing biorational approach.

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6. References

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