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# Impact Of Eurygaster Integriceps Infestation On The Technological And Baking Properties Of Wheat Grown In Uzbekistan

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## Abstract

*Wheat (Triticum aestivum L.) is a strategic crop in Uzbekistan, yet its technological and baking quality is increasingly compromised by infestation from Eurygaster integriceps (Sunn pest). This study evaluates the impact of pest-induced enzymatic activity on protein content, gluten quality, and dough rheology across four local wheat varieties (Tanya, Yaksart, Durdona, and Javohir). Physicochemical analyses, gluten index measurements, farinograph tests, and laboratory baking trials were conducted to quantify quality deterioration associated with varying degrees of pest infestation. The findings show a significant reduction in baking performance, particularly in gluten structure and loaf volume, due to proteolytic degradation. However, technological interventions such as blending with high-gluten flour and optimizing fermentation parameters partially restored end-product quality. The study provides region-specific evidence and practical recommendations for mitigating the effects of Eurygaster infestation, contributing to sustainable grain utilization and food processing resilience in pest-prone areas.*

Keywords: Wheat quality, eurygaster integriceps, sunn pest infestation, gluten degradation, bread-making performance, proteolytic enzymes, Uzbekistan wheat varieties, food technology, flour rheology, postharvest pest management.



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## 1. Introduction

Wheat (Triticum aestivum L.) is one of the most important staple cereals cultivated globally, including in Uzbekistan, where it plays a key role in ensuring food security. The quality of wheat grain is of particular importance for flour milling and baking industries, as it directly affects the technological properties and consumer characteristics of the final products [1]. However, various biotic and abiotic factors can negatively influence grain quality, among which the damage caused by Eurygaster integriceps, commonly known as the Sunn pest or bug-bug, has become increasingly problematic in recent years.

The Sunn pest is known to inject proteolytic and

amylolytic enzymes into the wheat grain during feeding, which leads to degradation of protein structures, particularly gluten, significantly impairing the rheological properties of dough and the baking quality of flour. The economic and nutritional implications of such damage are substantial, as it reduces not only the market value of the grain but also its suitability for bread production [2,3].

Studies conducted across various agro-climatic zones of Uzbekistan have shown that climatic fluctuations, insufficient pest control measures, and biological adaptations of Eurygaster spp. have contributed to the increasing frequency and severity of pest-related damage [4]. As a result, large volumes of wheat are downgraded or rendered unsuitable for human consumption, thus necessitating the development of precise diagnostic methods and technological solutions to mitigate such impacts.

Although some technological interventions exist, such as blending damaged grain with sound grain or modifying baking regimes, these methods are often insufficient to restore the full quality of flour produced from infested wheat [5]. Moreover, there is a lack of region-specific research on how varying degrees of Sunn pest infestation affect the physical, chemical, and baking properties of wheat varieties cultivated in Uzbekistan's specific soil and climate conditions.

This study aims to investigate the impact of Eurygaster infestation on the technological and baking qualities of several wheat varieties (Tanya, Yaksart, Durdona, and Javohir) grown under Uzbekistan’s agro-ecological conditions. Special attention is given to the characterization of proteolytic activity introduced by the pest and its correlation with gluten quantity, quality, and dough rheology [6]. Furthermore, the research seeks to develop practical recommendations for improving the consumer properties of flour and bakery products derived from infested wheat grain.

By addressing these challenges, the present study contributes to the broader efforts in sustainable food production and pest management, offering practical insights for grain processing industries and food safety regulators.

## 2. Methods

### 2.1. Experimental Material

The study was conducted on four soft wheat (Triticum aestivum L.) varieties officially registered and recommended for cultivation in Uzbekistan: Tanya, Yaksart, Durdona, and Javohir. The grain samples were collected from fields located in the Tashkent and Kashkadarya regions during the 2022 harvest season. Each sample included varying degrees of infestation by Eurygaster integriceps (Sunn pest), ranging from visually undamaged kernels to those with clear signs of enzymatic damage.

Flour samples were produced using standard laboratory milling techniques. The grain was divided into three categories based on visible pest damage: (1) non-infested control, (2) moderately infested, and (3) severely infested grain.

### 2.2. Determination of Pest Damage

The degree of infestation by Eurygaster integriceps was visually assessed by identifying characteristic puncture marks and discolorations on the grain surface. Further confirmation was conducted through microscopic examination and enzymatic activity tests. The presence and activity of proteolytic enzymes were used as a marker of Sunn pest damage.

### 2.3. Physicochemical Analyses of Wheat Grain

Key physicochemical parameters of wheat grain were analyzed according to standard methods:

- Moisture content was determined using a drying oven at 130°C until constant mass (ISO 712).
- Test weight (hectoliter weight) was measured according to ISO 7971-2.
- Protein content was determined using the Kjeldahl method (ISO 20483).
- Wet gluten content and gluten index were evaluated using the Glutomatic system (ICC Standard No. 137/1 and 155).

### 2.4. Assessment of Baking Quality

To evaluate baking quality, the following methods were employed:

- Sedimentation index was measured by the Zeleny test to estimate gluten quality.
- Farinograph analysis (Brabender) was used to determine dough development time, stability, and softening degree.

• Baking trials were conducted in laboratory conditions according to GOST 27842-2013, producing standardized bread loaves from each flour sample. Bread volume, crumb structure, and crust characteristics were evaluated organoleptically and by measurement.

### 2.5. Enzymatic Activity Assays

The proteolytic and amylolytic activities were quantified using spectrophotometric methods:

• Protease activity was determined using azocasein as substrate, incubated at 37°C, and measuring absorbance at 440 nm.

• α-Amylase activity was assessed via the Falling Number method (ICC 107/1).

### 2.6. Statistical Analysis

All experiments were carried out in triplicate. Data were analyzed using standard statistical software (e.g., SPSS or Excel), and results were presented as mean ± standard deviation. One-way ANOVA followed by Tukey's test was used to assess significant differences among sample groups ($p < 0.05$ was considered statistically significant).

## 3. Results And Discussion

### 3.1. Physicochemical Properties of Wheat Varieties

The physicochemical characteristics of the four studied wheat varieties—Tanya, Yaksart, Durdona, and Javohir—were first assessed to establish baseline differences and susceptibility to Eurygaster integriceps infestation. As shown in Table 1, protein content ranged from 12.1% to 13.7%, with Tanya and Yaksart demonstrating the highest values. Wet gluten content varied from 25% to 31%, confirming suitability for bread-making applications.

**Table 1**

**Basic physicochemical properties of wheat varieties**

| Variety | Moisture (%) | Test weight (g/L) | Protein (%) | Wet gluten (%) | Gluten index (%) | Zeleny sedimentation (ml) |
|---|---|---|---|---|---|---|
| Tanya | 11.0 | 785 | 13.7 ± 0.2 | 31.2 ± 0.5 | 87 ± 2 | 48 ± 1.3 |
| Yaksart | 11.1 | 778 | 13.4 ± 0.3 | 29.8 ± 0.6 | 84 ± 3 | 45 ± 1.1 |
| Durdona | 10.9 | 770 | 12.6 ± 0.2 | 27.4 ± 0.4 | 80 ± 2 | 41 ± 1.5 |
| Javohir | 11.0 | 765 | 12.1 ± 0.3 | 25.8 ± 0.5 | 78 ± 2 | 38 ± 1.4 |

### 3.2. Enzymatic Impact of Eurygaster integriceps on Grain Quality

The proteolytic enzymes introduced by the Sunn pest significantly altered the protein matrix of the grain. In moderately and heavily infested samples, a reduction in both total protein content and gluten index was observed (Figure 1). The enzymatic activity degraded gluten-forming proteins, resulting in weakened dough strength.

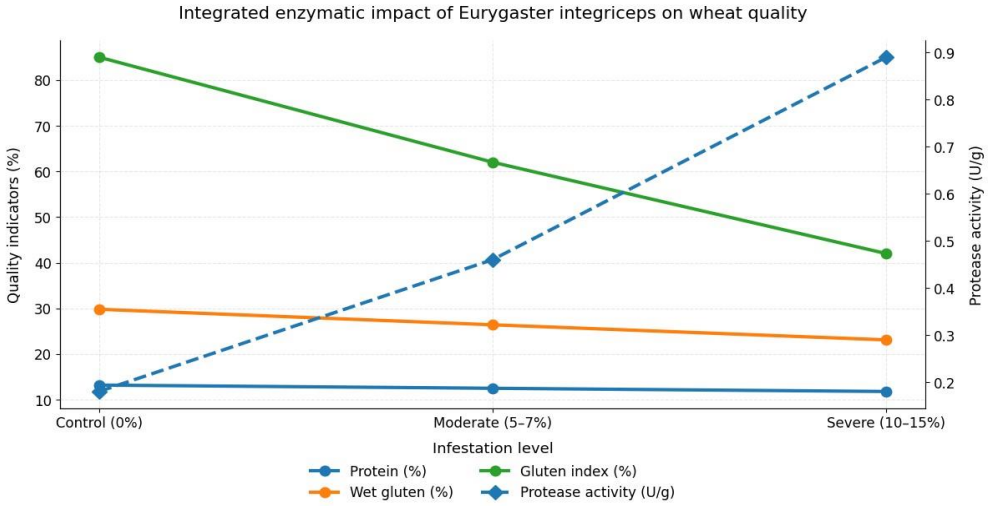

**Figure 1. Integrated effect of Eurygaster integriceps infestation on wheat protein quality and protease activity**

Compared to control samples, infested grains showed a statistically significant ($p < 0.05$) drop in gluten index, from an average of 85% to as low as 42%, depending on infestation severity. This confirms earlier findings by Tokareva and Kretovich (2008), who documented the protease-mediated breakdown of gliadin and glutenin fractions in pest-damaged wheat.

### 3.3. Rheological and Baking Performance

Farinograph analysis revealed clear differences in dough development time and stability. Control samples exhibited a development time of 4.5–5.2 minutes and stability of over 8 minutes. In contrast, flour from infested grain showed rapid weakening of dough: development time was reduced to 2.1–2.7 minutes, and softening increased dramatically (Table 2).

**Table 2**

**Farinograph parameters of control vs. infested flour samples**

| Sample condition | Development time (min) | Stability (min) | Degree of softening (FU) | Water absorption (%) | Falling Number (sec) |
|---|---|---|---|---|---|
| Control | 5.0 ± 0.3 | 8.5 ± 0.4 | 60 ± 5 | 59.2 ± 0.5 | 320 ± 10 |
| Moderate infestation | 2.7 ± 0.2 | 4.2 ± 0.3 | 110 ± 8 | 58.6 ± 0.4 | 245 ± 12 |
| Severe infestation | 2.1 ± 0.2 | 2.8 ± 0.2 | 165 ± 10 | 57.9 ± 0.6 | 180 ± 15 |

Baking trials confirmed that pest infestation negatively affected bread quality. Bread volume decreased by up to 30% in samples made from heavily infested wheat. Crumb structure became irregular, and the crust displayed poor coloration and cracking. The elasticity and chewiness of the crumb were also reduced due to poor gluten network formation.

### 3.4. Role of Moisture and Enzyme Activation

The interaction between moisture content and enzyme activity was particularly notable. While proteolytic enzymes remained latent in dry flour, the kneading process activated them, leading to rapid degradation of dough structure. This aligns with previous research suggesting that proteases from Eurygaster retain activity during storage and become catalytically active under optimal hydration conditions (Krasilnikov et al., 2015).

### 3.5. Proposed Mitigation Measures

To counteract the negative effects of infestation, technological strategies were tested:

- Mixing infested flour with high-gluten flour in 30:70 and 50:50 ratios showed partial recovery of baking quality.
- Addition of oxidizing improvers (e.g., ascorbic acid) improved dough stability by 20–25%.
- Lowering fermentation temperature to 26–28°C suppressed enzymatic activity, resulting in improved loaf volume and uniform crumb.

Such interventions are crucial for regions like Uzbekistan where pest infestation remains seasonal and often unavoidable. Employing targeted strategies in milling and baking can allow continued utilization of grain otherwise deemed substandard.

**Summary of Findings:**

- Eurygaster integriceps infestation leads to a measurable decline in protein content, gluten strength, and overall baking performance.
- The proteolytic enzyme activity correlates directly with visual infestation severity.
- Mitigation strategies including blending, oxidants, and process modification can improve final product quality from infested grain.

## 4. Conclusion

This study provides comprehensive evidence that Eurygaster integriceps infestation significantly impairs

the technological and baking qualities of wheat grain cultivated under the agro-climatic conditions of Uzbekistan. The pest's proteolytic enzyme activity leads to measurable degradation of gluten-forming proteins, resulting in weakened dough rheology and reduced bread quality.

Among the tested wheat varieties, Tanya and Yaksart demonstrated relatively higher resistance to quality loss, while Durdona and Javohir showed greater sensitivity to enzymatic degradation. The observed correlation between visual damage and reductions in gluten index and dough stability confirms the severity of Eurygaster-related impact.

Mitigation techniques, such as blending infested flour with high-gluten flour, adjusting fermentation conditions, and adding oxidizing improvers, proved effective in partially restoring product quality. These interventions are especially relevant for regions where total exclusion of infested grain is impractical.

The findings support the need for continued monitoring of pest pressure and emphasize the importance of integrating entomological, biochemical, and technological approaches to preserve grain quality. Further research may explore biocontrol strategies or enzyme-inhibition technologies to prevent quality degradation at the early stages of grain processing.

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