Research Article **AJAR (2022), 7:114**

American Journal of Agricultural Research (ISSN:2475-2002)

Determining the Falling number values and Enzyme activities in Wheat samples

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ABSTRACT

The falling number instrument analyzes viscosity by measuring the resistance of a flour and water paste to a falling stirrer. The level of enzyme activity measured by the falling number test affects product quality. If the falling number is too high, enzymes can be added to the flour in various ways to compensate. If the falling number is too low, enzymes cannot be removed from the flour or wheat, which results in a serious problem that makes the flour unusable. Falling number results were recorded as an index of enzyme activity in a wheat flour sample and the results were expressed in time as seconds. In this study six samples from Arsi Robe, four samples from Bekoji and two samples from Kulumsa were samples with high values of falling number that indicates minimal enzyme activity and sound quality wheat or flour. On the other hand two samples from Arsi Robe, three samples from Bekoji and two samples from Kulumsa were samples with low values of falling number that indicates substantial enzyme activity and sprout-damaged wheat or flour. In short from the total of wheat samples collected from each sampling sites, 67% from Arsi Robe, 44% from Bekoji and 22% from Kulumsa were samples with high falling number values and thus minimal enzyme activity. Similarly, 22% from Arsi Robe, 33% from Bekoji and 22% from Kulumsa were samples with low falling number values and the enzymes activities were substantial.

Keywords: Falling number; Wheat; Enzyme activity; Product quality; Substantial

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How to cite this article:
Abraha Gebregewergis. Determining the Falling number values and Enzyme activities in Wheat samples. American Journal of Agricultural Research, 2022; 7:114.

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Website: https://escipub.com/

Introduction

Wheat (*Triticum aestivum* L.) is one of the major cereal food crops in the world. It is one of the major cereal crops growing in Ethiopia[1]. Ethiopia is the second largest wheat producer (Araya et al., 2011) [4] in Africa. The area and production of wheat in 2011/12 cropping season was 11.89% and 13.34 % [6] respectively. Bread wheat *(Triticum aestivum* L.) and durum wheat (*Triticum turgidum* L. *var durum)* are the major wheat types dominantly growing in Ethiopia [7], with bread wheat dominantly growing [9].

Wheat is one of the most important cereal crops worldwide, in terms of production and utilization. It is a major source of energy, protein and dietary fibre in human nutrition and animal feeding. It provides approximately one-fifth of the total calorific input of the world's population[8]. Wheat is a grass of the gramineae family and of the genus *Triticum*. It is believed to be the first cereal crop grown by man and widely cultivated food crop in the world today. There are several thousand varieties known so far but three main types include *Triticum durum* (Durum wheat) largely used for pasta production, *Triticum vulgare* or *aestivum* mainly used for bread production and *Triticum compactum* (soft wheat) used for biscuit, pastry and cakes [5]. The grain is composed of branny husk 13%, germ 2% and endosperm 85%.

In Ethiopia, both the bread and durum wheat are widely cultivated in the highlands of the country largely in the areas like South East, Central and North West parts. According to Ministry of Agriculture and Rural Development [14], it is estimated that 1.4 million hectare of land is covered with wheat and more than 2.18 million tons are produced annually.

Global wheat production is concentrated mainly in Australia, Canada, China, European Union, India, Pakistan, Russia, Turkey, Ukraine and the United States, accounting for over 80% of world wheat production. Pakistan is the 8th largest wheat producer, contributing about 3.17% of the world wheat production from 3.72% of the wheat growing area. Wheat in Pakistan is a leading food grain and occupies a central position in agriculture and its economy[15].To enhance wheat production and productivity to satisfy the increased demand of the increasing population, use of high yielding, better quality and drought tolerant varieties[10], control insect pests and diseases, have been a big challenge in wheat producing areas. Application of supplemental and /deficit irrigation in limited amount in the moisture sensitive crop growth stages can enhance the crop yield and water productivity [11]. Efficient use of limited water and better growth under limited water supply conditions are important traits for crops in drought prone environments [10]. Wheat and flour specifications are communications between buyers and sellers. These specifications are requirements for particular wheat and flour characteristics. To meet these specifications, wheat and flour quality testing is necessary. Specifications for falling number, moisture content, ash content and protein content are determined with basic tests. The falling number instrument analyzes viscosity by measuring the resistance of a flour and water paste to a falling stirrer. The level of enzyme activity measured by the falling number test affects product quality. Yeast in bread dough, for example requires sugars to develop properly and therefore needs some level of enzyme activity in the dough. Too much enzyme activity, however, means that too much sugar and too little starch are present. Since starch provides the supporting structure of bread, too much activity results in sticky dough during processing and poor texture in the finished product. If the falling number is too high, enzymes can be added to the flour in various ways to compensate. If the falling number is too low, enzymes cannot be removed from the flour or wheat, which results in a serious problem that makes the flour unusable.

Methodology

Sample collection and preparation

27 wheat samples were collected from three different Arsi zone areas of Ethiopia (Arsi Robe,

Bekoji and Kulumsa), which are the most wheat productive regional areas. From each sampling sites 9 wheat samples were collected. The collected samples were kept in polyethylene bags. Some unwanted materials in the samples were removed and allowed to dry. The dried samples were ground by using Chopin CD laboratory mill and sieved to mesh size of 0.5 mm. Then the samples were stored in plastic bags (polyethylene) under airtight conditions until the time of falling number determination.

Procedures used to determine the falling number in the wheat flour

Perten Falling Number 1500 measures the alpha amylase activity in wheat (amount of sprouted grain and of yeast enzyme activity). The following procedures were used to determine the falling number in the wheat flour. First, a 7 g sample of wheat flour was weighed and combined with 25 ml of distilled water in a glass falling number tube with a stirrer and shaken to form a slurry. Then the slurry was heated in a boiling water bath at 100 ^{o}C and stirred constantly, the starch was gelatinized and forms a thick paste. Finally, the time it takes the stirrer to drop through the paste was recorded as the falling number value.

Results and Discussion

Falling number results were recorded as an index of enzyme activity in a wheat or flour sample and the results are expressed in time as seconds. A high falling number (for example, above 300 seconds) indicates minimal enzyme activity and sound quality wheat or flour. A low falling number (for example, below 250 seconds) indicates substantial enzyme activity and sprout-damaged wheat or flour. As shown in Table 1 six samples from Arsi Robe, four samples from Bekoji and two samples from Kulumsa have high values of falling number that indicates minimal enzyme activity and sound quality wheat or flour. On the other hand two samples from Arsi Robe, three samples from Bekoji and two samples from Kulumsa have low values of falling number that indicates substantial enzyme activity and sprout-damaged wheat or flour.

In short from the total wheat samples collected from each sampling sites, 67% from Arsi Robe, 44% from Bekoji and 22% from Kulumsa were samples with high falling number values and thus minimal enzyme activity. Similarly, 22% from Arsi Robe, 33% from Bekoji and 22% from Kulumsa were samples with low falling number values and the enzymes activities were substantial. The rest samples were samples with medium falling number values and the activities of the enzymes were normal. The falling number values for all samples collected from the three sampling areas are shown in Fig 1.

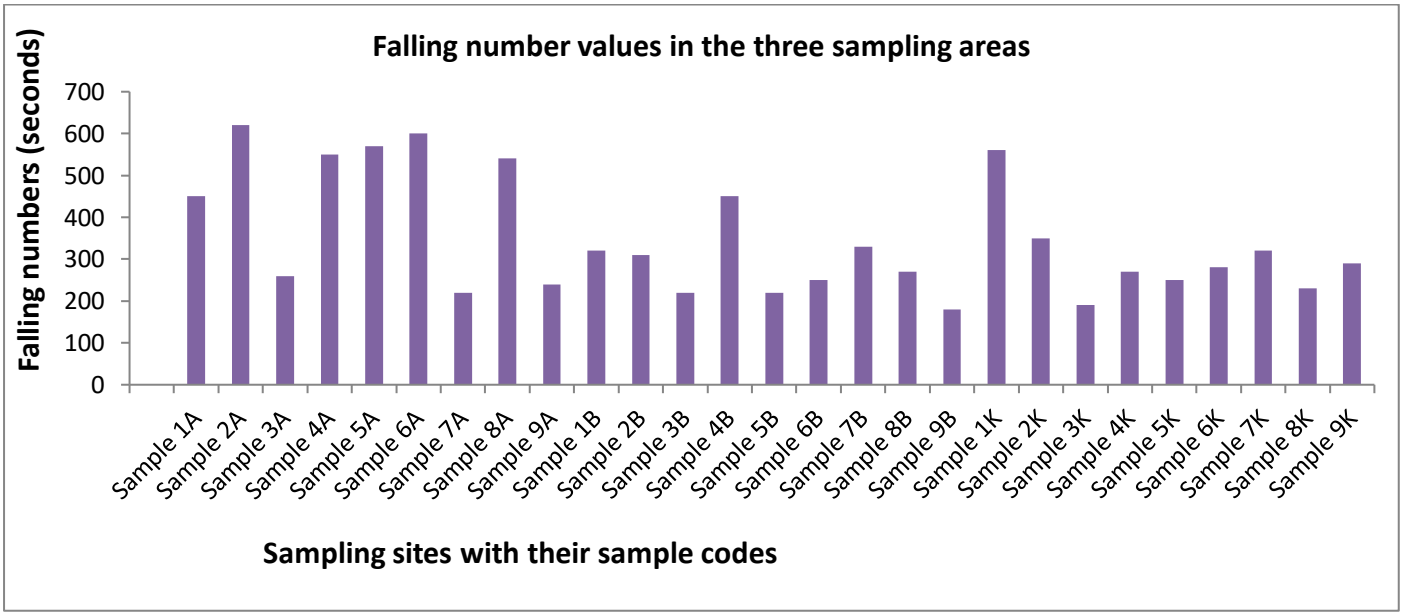

Fig. 1. Falling number values recorded in the three sampling areas

Table 1. The falling number values of the wheat samples (in seconds)

S/No.	Sampling site	Sample code	Falling number (seconds)	Description	
				Level of falling No.	Enzyme activity
1	Arsi Robe	Sample 1A	450	High	Minimal
2		Sample 2A	620	High	Minimal
3		Sample 3A	260	Medium	Normal
4		Sample 4A	550	High	Minimal
5		Sample 5A	570	High	Minimal
6		Sample 6A	600	High	Minimal
7		Sample 7A	220	Low	Substantial
8		Sample 8A	540	High	Minimal
9		Sample 9A	240	Low	Substantial
10	Bekoji	Sample 1B	320	High	Minimal
11		Sample 2B	310	High	Minimal
12		Sample 3B	220	Low	Substantial
13		Sample 4B	450	High	Minimal
14		Sample 5B	220	Low	Substantial
15		Sample 6B	250	Medium	Normal
16		Sample 7B	330	High	Minimal
17		Sample 8B	270	Medium	Normal
18		Sample 9B	180	Low	Substantial
19	Kulumsa	Sample 1K	560	High	Minimal
20		Sample 2K	350	High	Minimal
21		Sample 3K	190	Low	Substantial
22		Sample 4K	270	Medium	Normal
23		Sample 5K	250	Medium	Normal
24		Sample 6K	280	Medium	Normal
25		Sample 7K	320	High	Minimal
26		Sample 8K	230	Low	Substantial
27		Sample 9K	290	Medium	Normal

Conclusions

The falling number instrument analyzes viscosity by measuring the resistance of a flour and water paste to a falling stirrer. The level of enzyme activity measured by the falling number test affects product quality. Yeast in bread dough, for example requires sugars to develop properly and therefore needs some level of enzyme activity in the dough. Too much enzyme activity, however, means that too much sugar and too little starch are present. Since starch provides the supporting structure of bread, too much activity results in sticky dough during processing and poor texture in the finished product. If the falling number is too high, enzymes can be added to the flour in various ways to compensate. If the falling number is too low, enzymes cannot be removed from the flour or wheat, which results in a serious problem that makes the flour unusable.

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