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Research Progress on the Impact of Post-Rain Sprouting and Germination on Wheat Yield and Quality

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Abstract

During the wheat harvesting period, extreme weather events have frequently occurred, with an abundance of rainy days significantly impacting crop production. Following rainfall, sprouting and germination in wheat not only alter its external appearance but also lead to substantial changes in its intrinsic quality. This paper reviews the variations in yield, nutritional quality indicators, and processing quality metrics of sprouted and germinated wheat. Additionally, it explores new approaches for utilizing sprouted and germinated wheat.

Keywords

Sprouted Wheat; Germinated Wheat; Quality Indicators; Applications.

1. Introduction

Wheat is one of the most widely cultivated and highest-yielding cereal crops in the world, and it serves as an important commercial grain and strategic reserve crop in our country. The safe production of wheat and its yield directly impact national stability and farmers' income from agriculture. Wheat grains are also rich in dietary fiber, vitamins, starch, and various other nutrients. Sudden rain during the wheat harvest period adversely affects both concentrated harvesting and safe storage; often, due to overcast weather conditions, timely harvesting cannot be achieved, leading to sprouting or germination of grains on the ear. This situation increases pest infestations which severely affect both the yield and quality of wheat. When the proportion of sprouted or germinated wheat exceeds standard thresholds, it can result in difficulties selling these grains or necessitate selling them at lower prices, causing significant economic losses. Changes in quality traits associated with sprouted or germinated wheat have been reported domestically and internationally, primarily manifesting through physical and chemical alterations. This paper compares sprouted grains with normal grains to analyze their quality differences, providing a theoretical basis for enhancing the utilization rate of sprouted wheat while reducing unnecessary economic losses for farmers.

2. Impact of Post-Rain Sprouting and Germination on Wheat Yield and Quality

In recent years, extreme weather events influenced by climatic conditions have frequently occurred during crop harvest periods—characterized by persistently low temperatures coupled with increased rainfall—which has had severe negative impacts on agricultural production. Wheat is cultivated across various regions in our country; thus, ear sprouting represents a common natural disaster encountered during the harvest season within major

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wheat-producing areas. Ear sprouting refers to a phenomenon where unthreshed mature wheat encounters rainy or humid weather during storage prior to or after harvesting that causes seeds on the ear to germinate. Once ear sprouting occurs in wheat plants, a series of internal reactions take place that not only lead to yield loss but also significantly diminish both nutritional quality and processing characteristics.

2.1. The Impact of Post-Rain Sprouting and Germination on Wheat Yield

According to Abawi's report [1], in Australia, the yield loss caused by heavy rainfall during the harvest period is approximately 0.18% to 2.5%. Nawi [2] found through investigation and research on Australian agricultural meteorological data that rainfall during harvest can cause wheat lodging and even reduce the thousand grain weight of wheat, thereby severely reducing wheat yield. According to statistics, during the wheat harvest period in China, every moderate intensity rainfall will reduce the 1000 grain weight of wheat by 1-2g and result in a yield loss of at least 5%. As the rainfall intensity and time increase, the yield loss becomes more severe. As the degree of sprouting increases, the yield loss in some areas can reach up to 40%. For wheat with sprouting spikes, the nutrients in the grains are hydrolyzed, resulting in a decrease in grain weight and a higher risk of germination and mold growth during storage.

2.2. The Impact of Post-Rain Sprouting and Germination on the Nutritional Quality of Wheat

In the research of Li Yinian et al. [3], it was found that as the rainfall intensity gradually increases, the activity of proteolytic enzymes increases while the protein content gradually decreases[4]. Starch content accounts for more than half of the wheat endosperm. Once wheat is germinated, the material structure and internal quality of starch will change, which is another important reason for the decline in nutritional quality of wheat grains when exposed to precipitation during maturity. Wheat germination can cause starch hydrolysis, resulting in damaged starch and soluble sugars [5]. The lipids in the grains of wheat mainly undergo changes in two directions during or after germination. The first type is the oxidation reaction of lipids, which produces peroxides and unsaturated fatty acids after oxidation. The second type is due to the enhanced activity of lipase in grains, which hydrolyzes fats. The impact of rainfall during harvest on the sprouting and yield quality of spring wheat ears reduces the fat content [6].

2.3. The Impact of Post-Rain Sprouting and Germination on Wheat Processing Quality

The problem of sprouting can significantly reduce the processing quality of wheat. Gluten protein is used to determine the elasticity and viscosity of dough [7], Redman [8]Research has found that the activity of proteases increases during the germination process, hydrolyzing peptide bonds in gluten proteins, leading to gluten softening, difficulty in clumping, and reduced viscoelasticity. Ding et al. [9] found that as the germination degree increases, the water absorption rate of malt flour decreases and the weakening degree increases. The study by Zhang Yurong et al. [4] found that as the degree of sprouting increases, the formation time and stability time of the dough continuously decrease. With the extension of germination time, the stretching curve area, stretching resistance, maximum stretching resistance, and stretching ratio all show a decreasing trend.

3. New Ideas for the Utilization of Sprouted Wheat and Germination Wheat

Koehler et al. [10] also found that the content of folic acid in sprouted wheat is higher, mainly due to the increase in the number of methyl atoms in the raw material for synthesizing folic

acid. Foreign research has found that adding folic acid to infant formula can promote brain development. Therefore, we can seek new ways to utilize sprouted wheat based on its characteristics, such as processing special foods for pregnant women, which is a new idea. Van Hung et al. [11] found that the content of gamma amino acid (GABA) in germinated grains is higher than that in normal wheat. It is worth promoting the use of wheat flour prepared by adding different samples of wheat germ grains to reduce wheat yield loss in production. Marti et al. [12] pointed out that adding 1.5% malt flour to whole wheat flour can improve the volume and texture of bread to a certain extent. Wang Lina's [13] research shows that adding 10% wheat flour to normal wheat flour is more suitable for making bread with a soft texture.

The research conclusions of previous studies on the effects of different germination ratios of wheat mixed with normal grains on wheat quality have guiding significance for scientific management of wheat harvest period, food processing, and other aspects. For many years, we have only focused too much on its quality deterioration and overlooked its potential value. Existing research has demonstrated that both germinating and sprouting wheat possess unique nutritional value. Sprouted wheat can be made into whole wheat flour, which can be used to prepare new healthy foods based on its unique nutrients. It can also be processed into foods rich in folic acid to meet the needs of pregnant women for folic acid during pregnancy. The total amount of amino acids in sprouted wheat has significantly increased, and we can also develop sprouted foods based on this pattern. In this way, it can not only make full use of resources and reduce waste, but also minimize unnecessary economic losses for farmers. However, current research on sprouted wheat is still very limited, and it is necessary for us to continue to improve the study of the physicochemical quality of sprouted wheat in the future.

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