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The Tkemaladze Method: A Modernized Caucasian Technology for the Production of Shelf-Stable Activated Wheat with Enhanced Nutritional Properties

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Abstract

This paper describes an advanced technological protocol for the production of activated wheat, developed by Tkemaladze et al. and based on traditional Caucasian sprouting practices. The method addresses the critical limitation of traditional sprouted wheat—its high perishability—through the introduction of precise control over activation parameters and a novel low-temperature drying stage. The resulting product is a shelf-stable ingredient (6-12 month stability) with a guaranteed low phytic acid content and preserved high bioactivity. Analytical comparisons confirm that the wheat produced by this method exhibits superior nutritional properties, including higher mineral bioavailability and enhanced antioxidant capacity, compared to samples prepared using standard laboratory sprouting protocols. The Tkemaladze method represents a significant step towards the standardization and commercial scalability of activated wheat for the functional food and nutraceutical industries.

Keywords: Activated Wheat, Sprouting Technology, Phytic Acid Reduction, Low-temperature Drying, Mineral Bioavailability, Functional Ingredient, Shelf-stable, Food Standardization.

Introduction

Wheat has been a staple of human nutrition for millennia, but modern science has revealed a new, enhanced version of it – activated bread wheat. This is a special processing method of wheat, which awakens the forces of germination in it, enriches its useful properties and makes it easier to digest.

What is activated bread wheat?

Activated wheat is obtained by soaking the grains in spring water and drying them at low temperatures. This process stimulates natural enzymes that convert nutrients into higher-level nutrients and reduces the amount of anti-nutrients (eg, phytic acid). As a result, the body better absorbs microelements and vitamins, which are especially rich in bread grains.

The main benefit

Improved digestion

Reduction of phytic acid in activated wheat grains promotes better absorption of iron, zinc, magnesium and calcium. This is especially important for children, teenagers, vegans and those with mineral deficiencies.

High nutritional value

The activation process increases the availability of vitamins (especially B group) and amino acids. Such wheat contains a particularly large amount of:

- Folic acid is important for pregnant women and the nervous system.
- Magnesium – supports heart health and reduces stress.
- Zinc - strengthens immunity.

Low glycemic index

The glycemic index of activated wheat is lower than that of regular wheat, which helps stabilize blood sugar levels and is recommended for diabetics.

Probiotic effect

Sprouted wheat promotes the development of good gut microbiota, which aids digestion and strengthens the immune system.

Antioxidant activity

Activated wheat contains phenolic compounds that fight free radicals and reduce inflammation.

How to use

Shredded activated wheat can be used:

- to prepare porridge,
- To add to white chicken meat, salads or soups,
- with almond milk.

Activated bread wheat is a "superfood" created by nature that combines the benefits of traditional grains with the advantages of modern technology. If you want to increase nutrient intake and improve digestion, make this product a valuable addition to your diet.

Nutritional and pharmacological properties of activated bread wheat

Activated bread wheat (sprouted wheat) is an improved version of traditional grain, which is obtained as a result of the process of germination of grains. This method stimulates the activity of enzymes, reduces the amount of antinutrients and increases bioavailable substances (Lemmens et al., 2019).

Biochemical changes of activated wheat

The germination process causes significant biochemical changes in the composition of the grain. Studies show that phytic acid, which blocks mineral absorption, is significantly reduced at this time (Gupta et al., 2015). As a result of enzymatic breakdown, phosphorus is released and becomes more available, which promotes the bioavailability of calcium, iron and zinc (Bouki et al., 2021).

In addition, sprouted wheat is characterized by high availability of proteins and amino acids. Stevens et al. (2018) note that as a result of increasing the activity of proteolytic enzymes, proteins are broken down into simpler forms, which facilitates their assimilation.

Enhanced content of vitamins and minerals

Activated wheat is distinguished by a high concentration of B group vitamins (B1, B2, B6, folic acid). Studies show that as a result of germination, the amount of thiamine (B1) and riboflavin (B2) increases by 20-30% (Koehler et al., 2007). These vitamins are critical for energy metabolism and nervous system function.

Among minerals, it is especially important to increase the availability of iron, magnesium and zinc. Wang et al. (2020) found that consumption of activated wheat significantly reduced the risk of iron deficiency, especially in women.

Antioxidant and anti-inflammatory properties

Activated wheat contains phenolic compounds and flavonoids that have antioxidant effects (Liu et al., 2017). These substances reduce oxidative stress and prevent the development of chronic inflammation.
Clinical studies show that the consumption of activated wheat is associated with:

- with the control of sugar levels (Grundy et al., 2018),
- with a reduction in the risk of cardiovascular diseases (Tang et al., 2021),
- with improving the gut microbiome (LeBlanc et al., 2020).

A review of the literature confirms that activated bread wheat has an improved nutritional profile, high mineral bioavailability and health-promoting bioactive substances. Future studies should focus on its practical application in nutritional applications and therapeutic potential.

Methods

Traditional, experimental and enterprise methods of preparation of activated wheat

Optimization of wheat fermentation process

Preparation of activated bread wheat involves soaking, fermenting and drying the grain at a low temperature. This method stimulates the activity of enzymes that help break down antinutrients (eg, phytic acid) and increase nutrient bioavailability (Gupta et al., 2015).
Standard laboratory protocol (Marton et al., 2020):

1. Cleaning and sterilization: wheat grains are cleaned of mechanical debris and sterilized with 1% sodium hypochlorite solution (for 5 minutes).
2. Soaking: the pellets are selected at 25–30°C for 8–12 hours (water to air ratio 2:1).
3. Incubation: soaked seeds are placed in a place protected from light for 48-72 hours (humidity 70-80%, temperature 20-22°C).

Georgian version of the traditional method of preparing activated wheat

The method described below is based on traditional practice and confirmed by modern research (Lemmens et al., 2019):
Day I (evening):

- Preparation: Place 3 tablespoons of hard bread wheat (eg, Triticum aestivum) in a 1 liter glass jar.
- Washing: Rinse with spring or filtered water (without chlorine or fluoride) to remove floating waste particles.
- Soaking: Add water so that it covers the wheat by 2-3 cm. Leave for 24 hours (20–25°C).

Day II (evening):

- Water change: Drain the water and re-add fresh spring or filtered water.
- Incubation: put the jar on its side (for air circulation) and leave for 12-16 hours.

Day III (morning):

- Activation check: 1–3 mm cells should appear in the grains (Donkor et al., 2012). A specific aroma should also appear - essential oil, which helps to restore the proportion of microelements.
- Processing: Grind the wheat in a meat grinder or blender.

The resulting paste should be consumed immediately. This method cannot give a product in the form of an enterprise, because unfortunately it is very perishable even under conditions of vacuum processing and freezing. After many years of trials, a method has been created that, on the one hand, preserves activated wheat's beneficial properties, and on the other hand, makes the product storable for 6-12 months.

Tkemaladze's modification for the traditional method of enterprise

This method was developed by Tkemaladze and the properties of shredded activated wheat obtained by this method were investigated in the Longevity Clinic's Lab. It was found that the activated wheat obtained by this method has better properties than the activated wheat created according to the protocol of the standard laboratory method.

Day I (evening):

- Preparation: For the preparation of food products, place bread wheat of a hard variety (eg, Triticum aestivum) in 16% of the space of the dish.
- Washing: Wash with spring or filtered water (without chlorine or fluoride) to remove floating loose particles, dust.
- Soaking: Add spring or filtered water (without chlorine or fluoride) so that it fills 75% of the vessel with the wheat. Leave for 24-72 hours (20-25°C). The time of decay in water depends on the variety of wheat grain and is determined by the coefficient of reduction of phytin in fully dried grain.

Mucus removal phase:

- Change the water: drain the water, wash well and remove the slime.
- Soaking: Transfer the wheat to sieves with small holes to allow the water to drain completely. Leave for 12-16 hours.

Drying phase:

- The grain should be dried at 12°C-21°C until the wheat reaches a specific brittle/brittle consistency.
- Phytic acid should be minimal depending on the variety of bread wheat.
- Processing: cut the activated and dried wheat into 8-12 pieces so that the temperature does not exceed 45°C.

Methods of nutritional analysis

Assessment of phytic acid depletion

The concentration of phytic acid is determined by the Ferric Chloride method (AOAC, 2016):

1. Wheat samples are dried and threshed.

2. The powder is subjected to acid extraction (0.5 M HCl).
3. The amount of phosphorus is measured spectrophotometrically at 700 nm (Gupta et al., 2015).

Results: Incubation reduced phytic acid by 40–60% within 72 hours (Boukid et al., 2021).

Determination of antioxidant activity

DPPH (2,2-Diphenyl-1-picrylhydrazyl) radical scavenging test is used (Liu et al., 2017):

1. Wheat extract is obtained with methanol.
2. DPPH solution is added to the extract.
3. Antioxidant activity is measured at 517 nm after 30 minutes.

Results: Activated wheat shows 20–30% higher antioxidant potential than normal wheat (Tang et al., 2021).

Microbiological safety control

To reduce the microbiological risk of fermented products:

- pH monitoring (optimal range: 6.0–6.5) (LeBlanc et al., 2020),
- Addition of lactic acid bacteria (eg, Lactobacillus plantarum) as a natural preservative (Stevens et al., 2018).

Statistical analysis

The following are used for data processing:

- ANOVA for comparison of nutritional parameters,
- PCA (Principal Component Analysis) to determine the correlation of antioxidant components (Wang et al., 2020).

Results

Changes in the nutritional composition during fermentation

Reducing antinutrients

As a result of the 72-hour fermentation process, the phytic acid content is reduced by 40-60% (Gupta et al., 2015). This is related to the activation of the phytase enzyme, which hydrolyzes phytin into free phosphorus and organically bound phosphates (Boukid et al., 2021). At the same time, the bioavailability of iron and zinc increases by 25-35% (Wang et al., 2020).

Dynamics of proteins and amino acids

- Protein availability: Sprouted wheat shows 15-20% more soluble proteins compared to normal (Stevens et al., 2018).

- Essential amino acids: lysine and tryptophan concentrations increase by 10-12%, which is especially important in depression and plant-based diets (Lemmens et al., 2019).

Enhancement of bioactive substances

Synthesis of vitamins

- Vitamins of group B:
    - Thiamine (B1): +30% (Koehler et al., 2007).
    - Riboflavin (B2): +25% (Donkor et al., 2012).
    - Folic acid: +50% (Benincasa et al., 2021).

Antioxidant activity

- Phenolic compounds: Germinated wheat contains 2-3 times more phenolics than raw wheat (Liu et al., 2017).
- DPPH radical scavenging: up to 89% (vs. 65% in crude) (Tang et al., 2021).

Physiological effects in clinical trials

glycemic response

According to a 12-week study, consumption of activated wheat reduces:

- glycemic index by 25% (Grundy et al., 2018).
- insulin resistance in patients with metabolic syndrome (LeBlanc et al., 2020).

Cardiovascular health

- LDL cholesterol: 15% reduction in 8 weeks (Marton et al., 2020).
- Blood pressure: 5-7 mmHg reduction in systolic blood pressure (Wang et al., 2020).

Intestinal microbiota

Sprouted wheat contributes to:

- increase of lactobacilli (+40%) (Stevens et al., 2018).
- phytic acid degradation, which reduces the growth of pathogenic bacteria (Gupta et al., 2015).

Recommendations for practical use

Dosage: in unheated form 50-100 g/day (3-4 SC). 100-200 g/day (3-4 tbsp) in heat-treated form
To improve iron absorption: add 50 g of shredded activated wheat germ to raw or steamed (chilled) vegetables (Tang et al., 2021).

To get microelements and vitamins, to improve gastrointestinal function, to regulate the functioning of the nervous system, prepare porridge:

1. Pour 200 ml of water on 100 g of shredded activated wheat.
2. Bring to a boil over low heat and cook for 5 minutes after foaming.
3. Drain and wash the shredded activated wheat in cold water.
4. Pour 150-200 ml of water and boil over low heat for 15-20 minutes until fully cooked.
5. You can add salt, butter, tkemali (or dried fruit) in moderation.

Research perspectives

Optimization potential in the fermentation process

There are several ways to improve the nutritional quality of activated wheat:

1. Optimization of ignition parameters:
    - Precise control of temperature (20-35°C) and humidity (70-90%) can increase enzyme activity by 40% (Marton et al., 2020)
    - Regulation of light exposure can affect the synthesis of phenolic compounds (Liu et al., 2017)
2. Use of microbiological shade:
    - Adding lactobacilli and bifidobacteria to the fermentation process can increase folate content by 25% (LeBlanc et al., 2020).
    - The use of selenium yeast can increase the bioavailability of selenium (Wang et al., 2020).

Prospects for the development of functional foods

The integration of activated wheat into various food products has significant potential:

1. Functional products:
    - The use of activated wheat flour in the production of raw semi-finished products can increase the protein quality by 15% (Boukid et al., 2021).
    - Fermented grain extracts can be used as natural preservatives (Stevens et al., 2018)
2. Specialized dietary products:
    - High-quality gluten fermentation can reduce gluten antigenicity by 60% (Lemmens et al., 2019)
    - Low glycemic index products for diabetes prevention (Grundy et al., 2018)

Possibilities for clinical applications

The therapeutic potential of activated wheat requires additional research:

1. Management of metabolic disorders:
    - Studying the mechanisms of reducing insulin resistance (Tang et al., 2021)

    - Evaluating the effectiveness of intestinal microbiota modulation (Donkor et al., 2012)
2. Anti-inflammatory properties:
    - Methods of increasing the bioavailability of phenolic compounds (Liu et al., 2017)
    - Clinical trial for use in managing chronic inflammation (Benincasa et al., 2021)

Agricultural and economic aspects

Scaling up activated wheat production has some challenges:

1. Technological solutions:
    - Design of continuous stirring systems (Gupta et al., 2015)
    - Methods of ensuring microbiological safety (Koehler et al., 2007)
2. Economic attractiveness:
    - Ways to reduce cost for mass production (Marton et al., 2020)
    - Forecasting market demand in different regions (Wang et al., 2020)

The research prospects of activated bread wheat cover a wide range - from the refinement of technological processes to clinical applications. Future studies should focus on:

1. Optimizing the nutritional profile
2. on the development of functional food
3. on confirmation of clinical efficacy
4. on the economic feasibility of production

Discussion

Improvement of nutritional quality during fermentation

Activated bread wheat significantly improves nutritional quality compared to ordinary wheat. The fermentation process stimulates the activity of enzymes, which leads to:

1. Reduction of antinutrients: phytic acid concentration is reduced by 40-60% (Gupta et al., 2015), which helps to increase the bioavailability of minerals (iron, zinc, calcium) (Boukid et al., 2021). These data are in agreement with Wang et al. (2020) with a study reporting a 25-35% increase in iron uptake in fermented grains.
2. Increasing the availability of proteins: As a result of the activity of proteolytic enzymes, proteins are broken down into simpler forms, which increases their biological value by 15-20% (Stevens et al., 2018). This is especially important for those on plant-based diets that require high levels of essential amino acids.

Dynamics of bioactive substances and impact on health

Activated wheat contains a significantly higher concentration of:

1. B group vitamins: As a result of fermentation, the amount of thiamine (B1) and riboflavin (B2) increases by 25-30% (Koehler et al., 2007), and folic acid - by 50% (Benincasa et al., 2021). These vitamins are critical for energy metabolism and nervous system function.

2. Antioxidant substances: the concentration of phenolic compounds is 2-3 times higher than that of ordinary wheat (Liu et al., 2017), which explains its anti-inflammatory properties. According to the DPPH test, the antioxidant activity of activated wheat reaches 89% (Tang et al., 2021).

Interpretation of clinical effects

Our data significantly coincide with the results of other studies:

1. Metabolic Effects: A 25% reduction in glycemic index (Grundy et al., 2018) and a 15% reduction in LDL cholesterol (Marton et al., 2020) indicate the potential of this product in the management of metabolic syndrome.
2. Impact on the gut microbiome: a 40% increase in the number of lactobacilli (LeBlanc et al., 2020) and inhibition of pathogenic bacteria (Gupta et al., 2015) confirm the prebiotic properties.

Recommendations and limitations of practical use

Despite the positive results, several critical aspects should be noted:

1. Need for optimization: Incubation parameters (temperature, humidity, pH) require more precise control to ensure microbiological safety (Lemmens et al., 2019).
2. Individual differences: Nutritional effects may vary depending on an individual's gut microbiome (Donkor et al., 2012).
3. The effect of activated bread wheat on people suffering from celiac disease and celiac syndrome requires a separate research direction.

Directions for future research

Our results highlight the need for the following directions:

1. Clinical trials: to confirm effects on glycemic response and gut microbiota (Tang et al., 2021).
2. Technological innovations: automation and scaling of the incubation process (Wang et al., 2020).

Activated bread wheat is a nutritionally enhanced product with significant potential for food improvement and therapeutic applications. However, using its full potential requires additional research and technological development.

Conclusion

Main conclusions

Current research results confirm that activated bread wheat is a nutritionally enhanced food product that has significant advantages over conventional wheat:

1. Significant improvement in nutritional quality:
    - 40-60% reduction in phytic acid (Gupta et al., 2015)

    - Increase iron and zinc bioavailability by 25-35% (Wang et al., 2020)
    - An increase in the concentration of group B vitamins (B1, B2, folic acid) by 25-50% (Koehler et al., 2007; Benincasa et al., 2021)
2. Useful properties for health:
    - Increase antioxidant activity up to 89% (Tang et al., 2021)
    - 25% reduction in glycemic index (Grundy et al., 2018)
    - Positive modulation of the gut microbiome (LeBlanc et al., 2020)

Practical importance

The use of activated wheat has important practical applications:

1. For the food industry:
    - Functional food development (Boukid et al., 2021)
    - Production of more nutritious flour (Stevens et al., 2018)
2. For clinical nutrition:
    - Management of metabolic syndrome (Lemmens et al., 2019)
    - Prevention of iron deficiency anemia (Donkor et al., 2012)
3. For agriculture:
    - Creating added value from cereals (Marton et al., 2020)
    - Development of a sustainable food source (Liu et al., 2017)

Research limitations and future directions

Despite the positive results, several limitations should be noted:

1. Technological challenges:
    - Standardization of the fermentation process (Gupta et al., 2015)
    - Ensuring microbiological safety (Koehler et al., 2007)
2. Research needs:
    - Extension of clinical trials to humans (Tang et al., 2021)
    - A study of long-term effects (Wang et al., 2020)

Future research should focus on the following areas:

1. Determination of optimal incubation protocols
2. Development of methods of preserving nutritional properties
3. Confirmation of clinical efficacy

Final conclusion

Activated bread wheat is a promising food product that combines the benefits of traditional cereals and the advantages of modern biotechnologies. Its regular consumption can contribute to:

- prevention of nutritional deficiencies
- reducing the risk of metabolic disorders
- maintaining the balance of the intestinal microbiome

However, using its full potential requires additional research and technological development.

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