

Gold Farro Enzyme Capsulation

골드 파로효소 캡슐레이션

그레인온 | 상품 제안서



골드 파로효소
캡슐레이션

통곡물 TCP 파로 발효효소
(파로 97.58 %) 51.5 %
α-아밀라아제 : 1,000,000 unit / 1.8 g
프로테아제 : 5,400 unit / 1.8 g
효소식품 1.8 g × 30포(54 g / 220 kcal)



골드 파로효소
캡슐레이션

통곡물 TCP 파로 발효효소
(파로 97.58 %) 51.5 %
α-아밀라아제 : 1,000,000 unit / 1.8 g
프로테아제 : 5,400 unit / 1.8 g
효소식품 1.8 g × 30포(54 g / 220 kcal)

그레인온
Grain
on

What is Farro?



What is Farro?



The correct name is **Emmer Wheat** (*Triticum dicoccum*) — internationally known as “**Farro**.”

- ❖ Cultivated for over 12,000 years, Farro is one of the world’s earliest **super grains**.
- ❖ It is known as the “**Emperor’s Wheat**,” loved by **Julius Caesar**, and served as the **main staple grain** that fueled countless Roman victories — a true **treasure of Italy**.
- ❖ Compared to Kamut, another well-known ancient grain, **Farro contains three times less sugar**, making it a low-sugar grain ideal for modern diets.
- ❖ **Among all regions, Farro grown in Tuscany, Italy is considered the finest in quality.**
- ❖ According to EU agricultural regulations, Farro must be cultivated through crop rotation, allowing 2–3 years of resting period between harvests to preserve soil health and purity. All production is supervised by certified agronomists under the strict cultivation guidelines of CREA (Italian Council for Agricultural Research and Economics), ensuring the highest standards of quality and authenticity.



고대 이집트인들이 수확된
파로를 옮기는 모습

“10 Ancient Crops to Watch,” Selected by the Rural Development Administration (RDA) of Korea

Farro contains a total of 60 nutrients

Complex carbohydrates

17 types of vitamins

8 types of non-essential amino acids

10 type of essential amino acids

10 types of minerals

Calcium, potassium, sodium, iron, magnesium (alkaline), phosphorus, copper, zinc, manganese, and selenium.



Diet & diabetes

Ferulic acid, phytic acid, low sugar, resistant starch, dietary fiber, **arabinoxylan**

Antioxidant compounds

Carotenoids, lutein, zeaxanthin, polyphenols, selenium, **ferulic acid**

<https://www.alimentinutrizione.it/tabelle-nutrizionali/000020/>

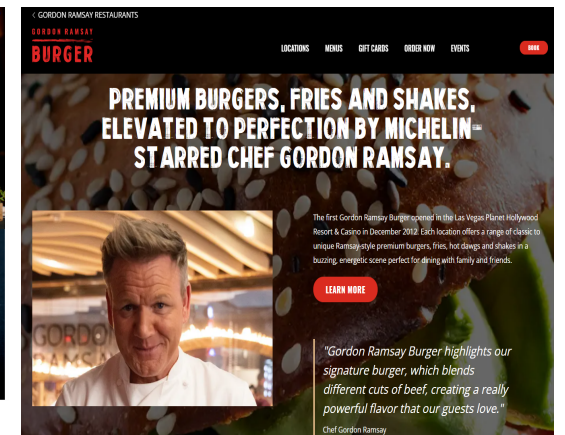
Farro is a popular health ingredient among renowned **international chefs** and **athletes**.

How to eat like an Olympian. Inside the world's largest restaurant feeding over 15,000 athletes and prioritizing plant-based meals over meat



Farro bowl

Olympic Athlete’s Diet:
Farro Bowl



British Celebrity Chef —
Gordon Ramsay



Roman Emperor Julius Caesar (General Caesar)

❖ The staple food of the Roman army

Farro, known as the “**Emperor’s Wheat**” loved by Caesar, became the most widely spread grain in ancient Rome and the staple food of the Roman army

❖ Use as currency

Farro held such significant value in ancient Rome that it was **used as currency**

❖ Sacrificial food

Farro was also used as sacrificial food in offerings to the gods during **religious ceremonies in ancient Rome**

During the transition from **the Roman Republic to the Roman Empire**, following **Julius Caesar’s successful conquest of Egypt**, he brought **Farro** back to Rome as part of the spoils of war. This marked the beginning of Farro’s widespread popularity throughout the **Roman Empire**, where it became a staple food symbolizing strength, nourishment, and imperial prosperity.



01 The Tuscany Environment

Rather than flatlands, higher altitudes with colder and drier climates provide the optimal conditions for Farro cultivation. The mountain ranges and dry climate of central Italy’s Tuscany region create **the perfect environment for growing high-quality Farro**.

02 Premium Grain

The **Tuscany region of Italy** follows **EU agricultural regulations**, practicing **crop rotation** that includes **a 2–3 year resting period** after each Farro harvest.

This sustainable method enriches the soil and ensures that Farro retains its superior quality.

As a result, Farro from Tuscany is regarded as **a premium grain**, rare and exceptional — a crop that cannot be produced or harvested at any time, but only through patience, care, and respect for nature’s rhythm.

03 Seed and Quality Preservation

In the **Tuscany region**, the use of **chemical pesticides, herbicides, and synthetic fertilizers** is strictly prohibited. Farmers are also required to **use locally preserved seeds**, which helps maintain the purity and genetic integrity of Farro.

All cultivation processes are **closely supervised by professional agronomists** under the **strict cultivation guidelines of the Italian Ministry of Agriculture (CREA)**.

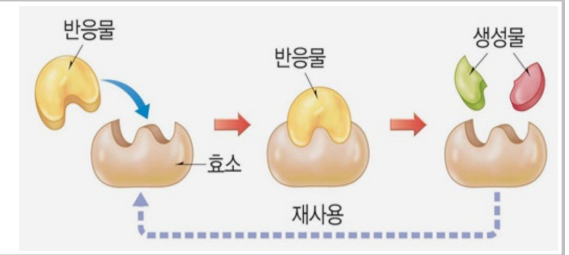
This rigorous oversight ensures that every grain of Tuscan Farro upholds its authentic lineage, superior quality, and sustainable heritage.

❖ What is enzyme?

* lays a key role in **breaking down food** and helping **carbohydrates, proteins, and fats** be converted into **bioavailable nutrients** that the body can use for **energy production**.

- An essential substance involved in **all metabolic activities** within the human body — including **digestion, absorption, decomposition, and excretion**.
- It acts as a **catalyst**, enabling the chemical reactions necessary for life to occur rapidly and efficiently.
- Without enzymes, life could not be sustained even for a single moment.

They are truly **indispensable for survival** — often called the “**Spark of Life**.”



❖ Needs

* The **amount of enzymes the human body can produce in a lifetime is limited**, and when these enzymes are completely depleted, life cannot be sustained.

- Since enzymes cannot be infinitely regenerated, the body's enzyme reserves naturally decline with age.
- Compared to children, the enzyme levels in the elderly are approximately 30 times lower.
- A lack of digestive enzymes can lead to indigestion, poor nutrient absorption, and even obesity due to a weakened sense of satiety.
- To ensure proper energy utilization and metabolic function, it is essential to maintain sufficient enzyme levels in the body through proper diet and supplementation.



#Indigestion #Obesity #Detoxification

In particular, Koreans consume more than three times the recommended daily intake of carbohydrates. Because of this carbohydrate-heavy diet, enzyme replenishment through external intake is essential!

According to the 2020 National Nutrition Survey, Koreans consume over three times the recommended daily intake of carbohydrates(Source: 2020 Dietary Reference Intakes for Koreans).In addition, the obesity rate among Koreans has been steadily increasing(Source: National Health Information Portal, KDCA).

❖ Benefits of Enzymes

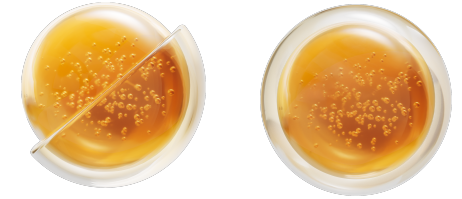
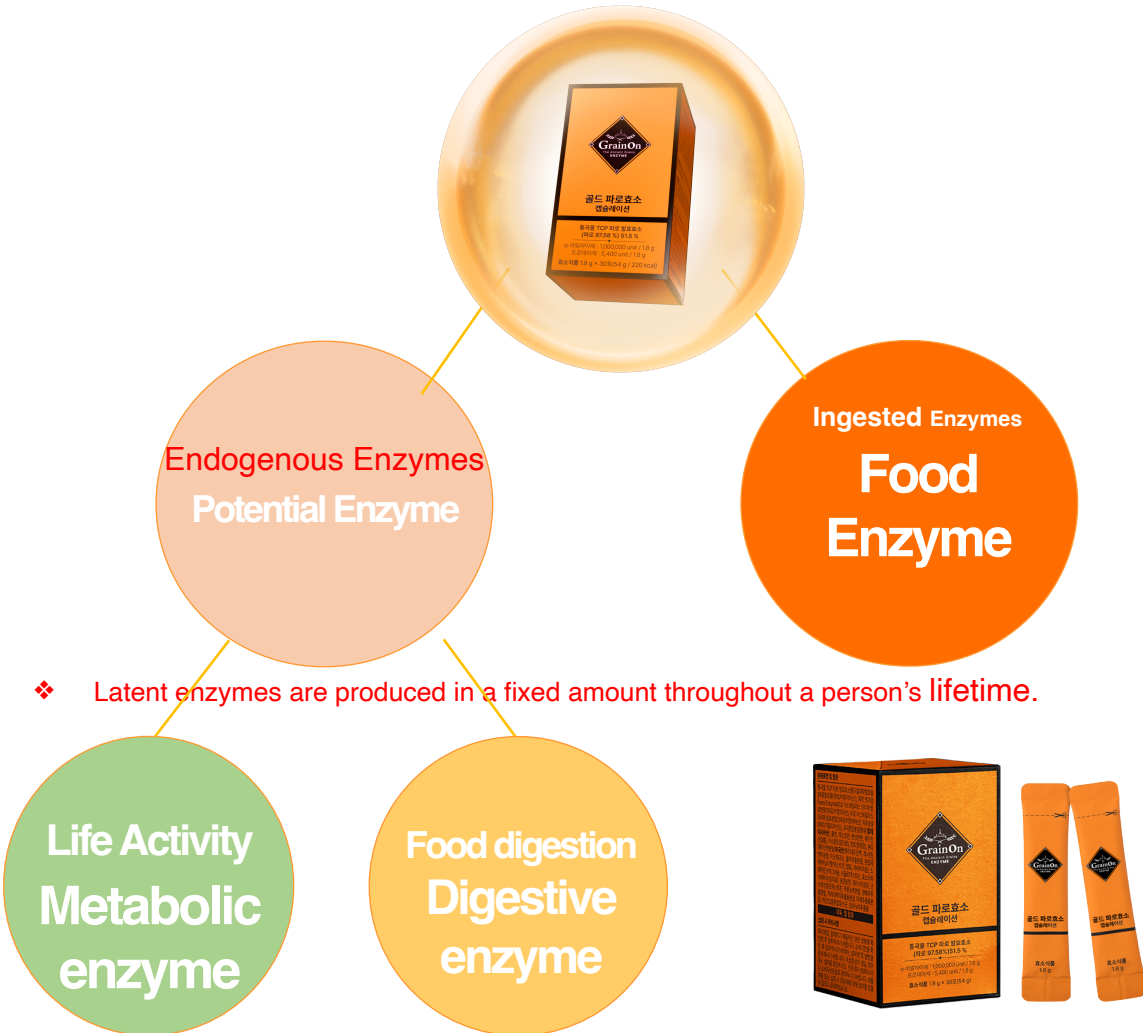
- ① Through the action of enzymes, nutrients in food are broken down into forms that are easier for the body to absorb, enabling efficient nutrient delivery.
- ② This promotes better nutrient absorption and enhances the bioavailability of vitamins, minerals, and other essential compounds.
- ③ During metabolic processes, body fat, waste materials, and toxins are decomposed and eliminated with the help of enzymes, contributing to detoxification and weight balance.
- ④ Enzymes also help prevent constipation and stimulate metabolism, supporting overall digestive and metabolic health.
- ⑤ Additionally, thanks to their detoxifying and antibacterial properties, enzymes promote faster wound healing and assist in reducing inflammation within the body

❖ What is Enzyme Potency (Activity)?

Enzyme potency refers to the measure of an enzyme's content and activity level — essentially indicating how much enzyme is present and how active or effective it is in catalyzing a specific reaction.

Essential for the Human Body

ENZYME



❖ Digestive Enzymes & Metabolic Enzymes

- 1) **Digestive Enzymes**: Help digest and break down food, aiding in the absorption of nutrients.
- 2) **Metabolic Enzymes**: Help convert digested and absorbed nutrients into usable energy for the body

The total amount of enzymes in the body is limited → **As we age, the amount of enzymes naturally decreases.**

If digestive enzymes are lacking, the amount of metabolic enzymes decreases → **resulting in a lower basal metabolic rate.**

A decrease in basal metabolic rate caused by indigestion prevents proper utilization of nutrients, leading to **fat accumulation** and an increased risk of **obesity!**

The powerful **encapsulation coating of Farro Enzymes** allows them to survive from the **stomach all the way to the intestines**, helping to **improve digestion**, **support gut health**, and **promote weight loss!**

1

Encapsulated Enzymes That Reach the Intestines!

- ✓ Known as the “**Intestinal Enzyme**,” it features **encapsulation coating** that allows it to **reach the end of the intestines intact**.
- ✓ **Enzyme Encapsulation** = Enclosing the enzyme with a protective coating that allows it to **survive stomach acid** from the moment it's ingested until it reaches the intestines, **aiding digestion throughout the process!**
- ✓ Most enzymes are digested by stomach acid before reaching the intestines, but **Farro Enzyme Encapsulation** delivers enzymes **intact all the way to the intestines**, enabling **more powerful food breakdown!**

Easy to Take + Powerful, Lasting Benefits

- ✓ Convenient one-time intake with a **minimum dose of 1.8g**
- ✓ **Enzyme potency: 1,000,000 units** for enhanced effectiveness — UP UP UP!
- ✓ Can be taken **anytime — before or after meals**
- ✓ Maximized nutrient content of Farro through **enzyme fermentation**
Arabinoxylan — Rich in dietary fiber, helps promote satiety and supports weight control
Ferulic Acid — Enhances digestive enzyme activity and is effective against inflammatory bowel conditions

3

• • •



Gluten-Degrading + Alkaline Enzymes

- ✓ Now, enzymes not only **break down carbohydrates** but also **degrade gluten!**
- ✓ For modern people who mainly consume acidic foods, **alkaline enzymes** are essential.
- ✓ The stomach maintains a slightly **alkaline environment (pH 7–8)**, making these enzymes perfectly optimized for intestinal health.
- ✓ Featuring an alkaline coating process for enhanced stability and performance.

‘100% Naturally Fermented with L’ecce! Granotoscan Farro

- ✓ 100% **Naturally Fermented Using Only Single-Origin Farro from Tuscany, Italy!**
- ✓ **ZERO refined enzymes!**
Each grain has a different fermentation point, so when multiple grains are fermented together, their nutrients cannot be fully preserved.
However, **Farro Enzyme** is fermented **exclusively with single-origin Farro**, capturing **100% of its natural nutrients**.
Even the **nutrient source for the fermentation bacteria comes only from Farro itself!**

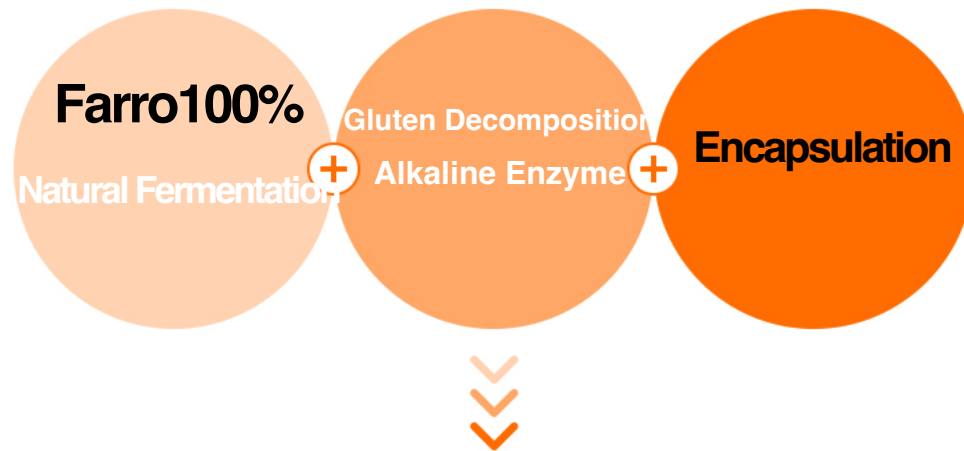
2

4

Gold Farro Enzyme Encapsulation



The Rich Nutrition of Farro



Why Farro Enzyme?

Fermenting Farro maximizes its nutritional value!
Supports **both weight management and gut health!**
Survives stomach acid and **reaches the intestines intact!**



❖ With just one sachet a day, you can enjoy all the nutritional benefits of Farro!



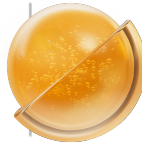
The First and Only in Korea!

Encapsulation Coating — Reaches All the
Way to the Intestines!
**Enzyme Fermented with 100% Farro from
Tuscany, Italy**

❖ Why Farro Enzyme?

★ Enzyme Encapsulation ★

- ✓ Conventional enzymes are destroyed by stomach acid —but with patented encapsulation technology, **these “Intestinal Enzymes” survive the stomach and reach the intestines intact!**



Various Benefits and Effects

- ✓ Carbohydrate breakdown, gluten decomposition, **fiber** and alkaline enzymes.
- ✓ Rich in antioxidants such as **arabinoxylan** and **ferulic acid**.
- ✓ Prevents imbalance in gut microbiota and improves intestinal health.
- ✓ Abundant in **dietary** and **short-chain fatty acids**.
- ✓ Contains over **60 types of nutrients** naturally found in Farro.



when consuming Farro Enzyme

- * **Digestion, Inflammatory Bowel Disease Relief, and Gut Health Improvement**
- * Rich in **dietary fiber** and **short-chain fatty acids**
 - Helps remove intestinal toxins and promotes **weight loss**
- * Enhances **digestive enzyme activity** and supports **smooth bowel movements**
- * Prevents **skin aging** and boosts **immune strength**
- Aids digestion of **acidic foods**
 - **alkaline enzymes**
- Reaches the intestines without being destroyed by stomach acid
 - **Better digestion! Stronger effect! Less fat!**



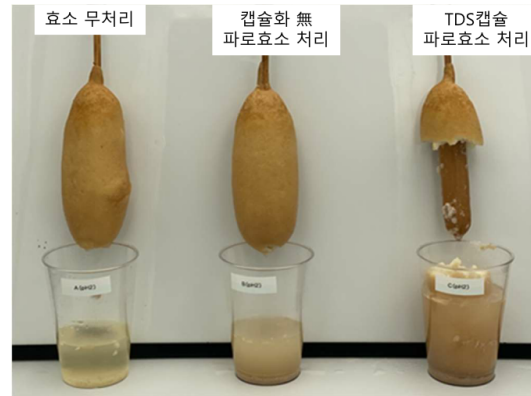
Product name	Farro Enzyme
Food type	Enzyme food
Content	1.8g * 30sachet (54g)
Ingredients and content	Whole Grain TCP Farro Fermented Enzyme [Whole Grain Farro Fermentate {Farro Fermentate (Farro / Product of Italy)}, Farro Enzyme {Farro <i>Aspergillus oryzae</i> Fermented Powder 1 (Farro / Product of Italy), Farro <i>Aspergillus oryzae</i> Fermented Powder 2 (Farro / Product of Italy), Farro Powder (Farro / Product of Italy)}]
Product number	20100182300-236
Contents per sachet	α - Amylase : 1,000,000unit / 1.8g Protease : 5,400 unit / 1.8g
Precautions for consumption	1) Consuming with hot water may destroy the enzymes due to heat. 2) The effects of this product may vary depending on the individual's physical condition. 3) If you have allergies, please check the ingredients before consumption. 4) Those undergoing treatment for any illness should consult a doctor or pharmacist before taking this product.
Best Before	until the date on the side label
Storage instructions	Please store in a cool, dry place, away from high humidity and direct sunlight

Hot Dog Decomposition Test

위 환경 (pH 2)



3시간 후



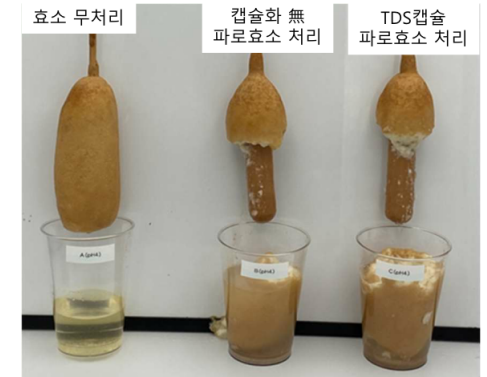
[실험 결과]

- ① 모든 pH 조건에서 효소가 없는 A는 핫도그가 분해되지 않은 모습을 보임. 효소가 핫도그를 분해함을 알 수 있음.
(다만 핫도그에서 핫도그 빵만 분해되는 모습을 보임.)
- ② pH 조건 별로 보았을 때 TDS캡슐 파로효소(C)는 모든 pH 조건에서 핫도그를 분해하였지만 캡슐화 無 파로효소(B)는 pH2 조건에서 핫도그를 분해하지 못함.
(위 조건에서의 핫도그 분해력 : TDS캡슐 파로효소(C) > 캡슐화 無 파로효소(B) = 효소 무처리(A))

장 환경 (pH 4)



3시간 후



[실험 결과]

- ① 모든 pH 조건에서 효소가 없는 A는 핫도그가 분해되지 않은 모습을 보임. 효소가 핫도그를 분해함을 알 수 있음.
(다만 핫도그에서 핫도그 빵만 분해되는 모습을 보임.)
- ② 위 pH조건에서 캡슐화 전/후 효소처리 제품의 분해 정도의 큰 차이는 보이지 않음.
(위 조건에서의 핫도그 분해력 : TDS캡슐 파로효소(C) = 캡슐화 無 파로효소(B) > 효소 무처리(A))

[Hot Dog Decomposition Test]

Farro Enzyme Encapsulation > Conventional Farro Enzyme = No Enzyme Treatment

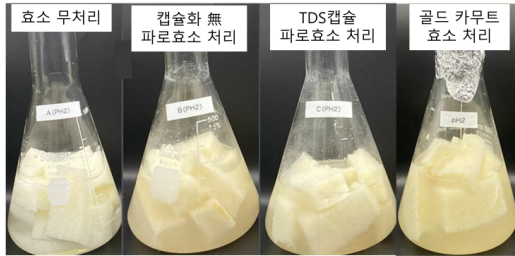
In a simulated stomach environment, the **decomposition rate of conventional Farro enzymes** showed **no significant difference** from the untreated sample.

However, **Farro Enzyme Encapsulation** demonstrated **much higher digestive power** even under stomach conditions.

Unlike conventional enzymes that are easily destroyed by high acidity, **encapsulated Farro enzymes** maintained strong **decomposition efficiency** throughout the process.

Gold Farro Enzyme Encapsulation Degradation Experiment

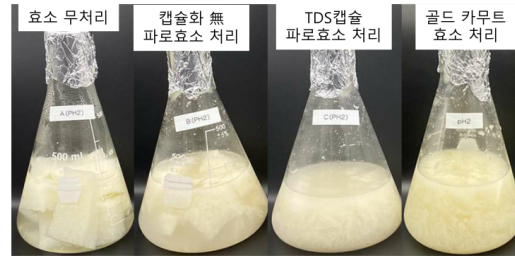
위 환경 (pH 2)



[실험 결과]

- pH 2에서 전체적으로 분해도가 다른 pH에 비해 떨어지나, 캡슐효소의 분해 정도가 월등함.(캡슐 함으로서 내산성 효과 있음.)
- 육안상 분해된 정도 : TDS캡슐파로효소>골드카무트효소>(캡슐화 無)기존파로효소

장 환경 (pH 4)



[실험 결과]

- 캡슐효소의 분해 정도가 월등함.(캡슐 함으로서 내산성 효과 있음.)
- 육안상 분해된 정도 : TDS캡슐파로효소>골드카무트효소>(캡슐화 無)기존파로효소

캡슐효소의 분해 정도가 월등함 확인

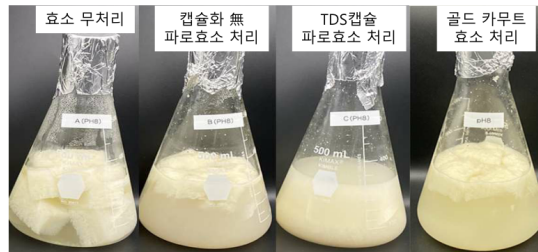


알칼리 환경 (pH 8)



[실험 결과]

- 캡슐효소의 분해 정도가 월등함.(캡슐 함으로서 내알칼리성 효과 있음.)
- 육안상 분해된 정도 : TDS캡슐파로효소>골드카무트효소>(캡슐화 無)기존파로효소



[Bread Decomposition Test]

Farro Enzyme Encapsulation > Farro Enzyme = Gold Kamut Enzyme > No Enzyme Treatment
In simulated stomach, intestinal, and alkaline environments, tests confirmed that Farro Enzyme Encapsulation exhibited the highest decomposition activity across all conditions.

Inhibition of *Salmonella* Typhimurium Biofilm Formation, Adhesion, and Invasion by Whey Beverage Supplemented with *Triticum dicoccum* (Farro) Enzyme

and explore the underlying mechanisms. Treatment with WF significantly reduced biofilm formation and viability of *S. Typhimurium*. Moreover, WF decreased the bacterial adhesion to and invasion of human intestinal epithelial cells. WF also inhibited gene expression associated with motility and initial adhesion in *S. Typhimurium*, as well as genes involved in quorum sensing (QS), in a concentration-dependent manner. Furthermore, WF suppressed the production of the QS signaling molecule autoinducer-2 in a similar concentration-dependent manner. Consequently, our findings indicate that the addition of enzyme-rich fermented farro to whey beverage enhances anti-biofilm activity, which is probably attributed to its antimicrobial effects, inhibition of initial adhesion, and QS reduction. These findings offer a promising basis for developing fortified dairy beverages

→ Enzyme-rich fermented farro helps inhibit harmful bacteria that cause intestinal diseases and exhibits anti-biofilm and antibacterial effects.

Conclusion

This study highlights the potential of whey beverages supplemented with farro enzyme as a functional component for enhancing the antibacterial and anti-biofilm properties of whey beverage. The addition of whey beverage supplemented with farro enzyme significantly inhibited *S. Typhimurium* biofilm formation and reduced bacterial adhesion as well as invasion of intestinal epithelial cells. The concentration-dependent suppression of biofilm formation was associated with the downregulation of motility, adhesion, and QS-related genes, as well as inhibiting AI-2 production. These findings suggest that whey beverage supplemented with farro enzyme exerts anti-biofilm activity via multiple mechanisms, including antimicrobial action, interference with initial bacterial adhesion, and disrupting QS signaling. This research offers a promising foundation for

→ The antibacterial and anti-biofilm properties of beverages containing farro enzymes help inhibit the growth of harmful bacteria and support the improvement of intestinal health

Alginate-based materials for enzyme encapsulation

Yilun Weng^a, Guangze Yang^b, Yang Li^a, Letao Xu^a, Xiaojing Chen^c, Hao Song^a, Chun-Xia Zhao^{a,b,*}

ABSTRACT

Enzymes are widely used in industry due to their high efficiency and selectivity. However, their low stability during certain industrial processes can result in a significant loss of catalytic activity. Encapsulation is a promising technique that can stabilize enzymes by protecting them from environmental stresses such as extreme temperature and pH, mechanical force, organic solvents, and proteases. Alginate and alginate-based materials

→ Encapsulated enzymes can be stabilized by protecting them from temperature, acidity, and other environmental stresses.

chemical modifications, and mild gelation conditions. The encapsulated enzymes present significantly improved stability under unfavorable conditions, compared with native enzymes. This review provides an

→ Encapsulated enzymes are more stable than conventional natural enzymes.

Effect of the Encapsulation Process on the Viability of Probiotics in a Simulated Gastrointestinal Tract Model Medium

Madina Jumazhanova ^{1,*}, Zhaynagul Kakimova ¹, Yerlan Zharykbasov ¹, Samat Kassymov ¹,
Gulmira Zhumadilova ¹, Alibek Muratbayev ¹, Marzhan Tashybayeva ¹ and Anuarbek Suychinov ²

Abstract: The primary objective of this study was to investigate the survival rate of three species of encapsulated bacteria (*Propionibacterium acidipropionici*, *Propionibacterium freudenreichii*, and *Propionibacterium thoenii*) in model solutions designed to simulate the acidity levels found within the human gastrointestinal tract. The capsules were prepared by extrusion from gelatin and sodium alginate in a 1:1 ratio on a laboratory encapsulator. The use of gelatin and sodium alginate was found to provide optimum characteristics suitable for encapsulation of live bacteria. Three strains of *Propionibacterium asidirgorionici*, *Propionibacterium freudenreichii*, and *Propionibacterium thoenii* were subjected to in vitro assay to evaluate their probiotic potential. The final cell survival rate of *P. freudenreichii* was 10⁵ CFU/mL, indicating that this probiotic is sensitive to acidic medium. The viability of encapsulated probiotics was studied in a model medium simulating the gastrointestinal tract. It was found that alginate–gelatin capsules could provide protection to *P. freudenreichii* from gastric acid and lead to high levels of viable bacteria released in the intestine. Practical application: Encapsulation of

→ Encapsulation helps protect enzymes from the acidity and gastric acid in the human gastrointestinal tract, thereby increasing their survival rate in the intestines.

Thus, the encapsulation method was found to be very effective in increasing the viability of probiotic bacteria compared to unencapsulated free cells. Alginate–gelatin capsules can potentially be used as a safe and protective delivery agent for viable probiotic bacteria. The data from the viability study showed that the alginate–gelatin capsules provided high probiotic protection, as the number of live microorganisms was at a high level after 3 h of probiotic capsule exposure in a simulated small intestinal environment. This characterizes that the capsules were able to deliver the live microorganisms through low-pH gastric juice to the small intestine where they will exert their functional properties on the human body. The viability data also indicated that the alginate–gelatin capsules

→ Encapsulation is more effective than non-encapsulation in enhancing the survival rate of probiotics.

Article

Enhanced Thermal and Storage Stability of Glucose Oxidase via Encapsulation in Chitosan-Coated Alginate and Carboxymethyl Cellulose Gel Particles

Zhihao Guo ^{1,2}, Jian Ren ^{1,2} and Chunli Song ^{1,2,*}

To enhance the stability of GOD, encapsulation is used as an effective strategy to protect GOD against environmental stress [5]. Alginate spheres are commonly utilized for

→ Encapsulation protects against environmental stress and enhances stability.

4. Conclusions

In this study, the synergy between SA and CMC was used to encapsulate GOD to enhance the encapsulation efficiency of GOD. The addition of CMC can improve the EE of GOD in alginate gel particles. On this basis, CS was added to coat the SA/CMC gel particles to further improve the stability of GOD. GOD's encapsulation in alginate gel particles (SA/CMC and CS/SA/CMC) was proven to improve its thermal and storage stability. Furthermore, the favorable bioactivity of the encapsulated GOD was achieved

→ Encapsulation improves nutrient efficiency, heat stability, and storage stability.

Role of the Encapsulation in Bioavailability of Phenolic Compounds

Josipa Grgić, Gordana Šelo^{ID}, Mirela Planinić, Marina Tišma^{ID} and Ana Bucić-Kojić *

Encapsulation is a method that can positively affect bioaccessibility and bioavailability as it ensures the coating of the active component and its targeted delivery to a specific part of the digestive tract and controlled release. This comprehensive review aims to present the role of encapsulation

entrapped mixture, and modify the physical properties of original substances. Encapsulation is also used to enhance the bioavailability of bioactive compounds, such as drugs and phenolic compounds, in a way that using various wall materials enable target delivery and controlled release (delayed or long-acting release) [95]. Numerous encapsulation techniques suitable for food ingredients have

to explain the absorption of phenolic compounds in the gastrointestinal tract. In terms of phenolic compounds bioavailability, encapsulation is a promising technique. It ensures the controlled supply and release of phenolic compounds to the target site in the test system where the best absorption of the active substance and its transfer to the tissues can be enabled. The effectiveness of the controlled delivery and release of the active substance, in this case, phenolic compounds, depends primarily on their structure, their interactions with other food ingredients, and among themselves, the properties of the encapsulation material and the encapsulation method used, but also on the intestinal microflora.

→ Encapsulation can have a positive effect on bioaccessibility and bioavailability.

→ Encapsulation enables improved bioavailability and controlled release.

→ Encapsulation enables optimal absorption and delivery of active compounds, enhancing their bioavailability.

Arabinoxylan ameliorates type 2 diabetes by regulating the gut microbiota and metabolites

Qixing Nie^a, Jielun Hu^a, Haihong Chen^a, Fang Geng^b, Shaoping Nie^{a,*}

metabolites. Arabinoxylan promoted the growth of fiber-degradation bacteria to increase SCFAs (acetic acid, propionic acid, butyric acid), as well as decreased the abundance of some opportunistic pathogens, including *Escherichia-Shigella* and *Desulfovibrio*. The improved gut

→ **Arabinoxylan increases short-chain fatty acids and reduces harmful bacteria.**

The effects and benefits of arabinoxylans on human gut microbiota – A narrative review

Arabinoxylans (AXs) are non-starch polysaccharides (NSP) found in cereal grains and have been previously identified as prebiotics (Damen et al., 2011; Grootaert et al., 2006). They have been found to be greatly beneficial in promoting the diversity and function of gut microbiota (Mendis et al., 2016). The structure of AXs varies amongst different cereal grains and even between the bran and endosperm from the same cereal (Wang et al., 2020). These structures are classified into branched and linear, with branched AXs showing greater performance in promoting the proliferation of microorganisms and increasing production of short-chain fatty acids (SCFAs) according to *in vitro* studies (Tuncil,

digestible fibre. Acting as a prebiotic, AX enables the stimulation of keystone gut microbial species, specifically *Bifidobacterium* spp. and *Lactobacillus* spp. The consequent beneficial effects include preventing dysbiosis of gut microbiota, arresting pathogen proliferation and ameliorating gastrointestinal disorders.

→ Arabinoxylan (AX) is a non-starch polysaccharide found in grains that acts as a prebiotic, promoting the growth of beneficial gut microbiota and enhancing the production of short-chain fatty acids.

→ Arabinoxylan (AX) helps prevent gut microbiota imbalance and suppresses the growth of harmful bacteria, thereby aiding in the improvement of gastrointestinal disorders.

Advance diversity of enzymatically modified arabinoxylan from wheat chaff

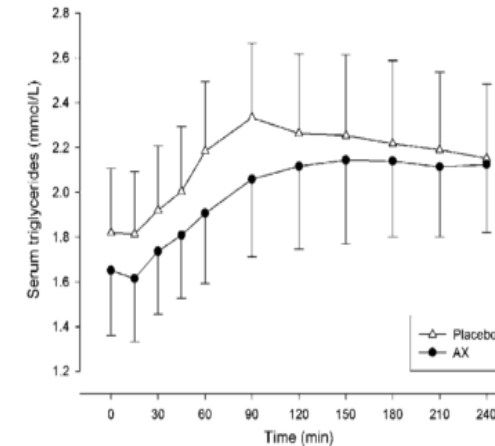
Tatjana Đorđević, Maja Milošević, Mirjana Antov*

actions successfully modified its structure reflecting in lowered viscosity. Besides, it has been observed that the synergistic actions of enzymes improved the biological activities of arabinoxylan more than twice. Chemometric classification analysis showed that synergistic enzymes' actions were predominantly responsible for the improvement of biological activities. It indicated that they might be a useful tool for diversification and enhancement of biological activities of arabinoxylan from wheat chaff.

→ **Arabinoxylan (AX) enhances biological activity more than twofold through synergistic interaction with enzymes.**

Arabinoxylan consumption decreases postprandial serum glucose, serum insulin and plasma total ghrelin response in subjects with impaired glucose tolerance

Serum triglycerides also increased after consumption of liquid meal ($P < 0.001$), but postprandial response was lower after AX consumption compared to placebo ($P = 0.048$; Figure 2). Serum NEFA decreased after consumption of liquid



Reduction of triglycerides after arabinoxylan intake

PlaceboArabinoxylan

Figure 2 Serum triglycerides after LMCT after 6 weeks intervention. Data are shown as geometric mean, error bars indicate geometric s.e.m., $n = 11$. Serum triglycerides ($P = 0.001$) were significantly lower after AX consumption compared to placebo.

→ After arabinoxylan intake, triglyceride levels were found to be lower compared to the placebo group.

In conclusion, AX consumption for 6 weeks improves postprandial serum glucose, insulin and triglyceride response in overweight subjects with impaired glucose tolerance. Furthermore, this was associated with decreases in total

→ Regular consumption of arabinoxylan helps reduce postprandial blood glucose, insulin, and triglyceride levels.

Nutritional and Nutraceutical Properties of *Triticum dicoccum* Wheat and Its Health Benefits: An Overview

Srinu Dhanavath and U.J.S. Prasada Rao 

Table 4–Dietary fiber and its components in dicoccum wheat.

Components	Content (%)	References
Total dietary fiber 식이섬유 (DF)	7.2 to 20.7	1, 2, 3, 4
Insoluble fiber	6.91 to 18.28	1
Soluble fiber	1.2 to 3.48	1
Total-AX 아라비노자일란 (AX)	1.4 to 2.2	2, 3
Water soluble AX	0.15 to 0.55	2, 3
β -Glucan	0.30 to 0.40	2, 4, 5
Lignin	1.95 to 2.65	2

of 9.8% (Gebruers and others 2008). AX is one of the major DF components of wheat and its content in dicoccum ranged from 1.4% to 2.2% and its bran was reported to be rich in AX (6.1% to 14.4%) (Gebruers and others 2008; Ward and others 2008).

levels of diabetic subjects. Incorporation of dicoccum flour in the regular diet of diabetic patients for 6 wk reduced 11% each of total lipids, triglycerides, and LDL cholesterol concentrations. A low starch digestibility of the food appears to be a reason for the management of hyperlipidaemia (Yenagi and others 2001).

→ Arabinoxylan is a type of dietary fiber abundantly found in emmer (farro).

→ When emmer (farro) was added to the diet of diabetic patients for six weeks, total lipids, triglycerides, and LDL cholesterol levels decreased by 11%, respectively. The high resistant starch content in farro helps in managing hyperlipidemia.

ORIGINAL ARTICLE

Postprandial effects of test meals including concentrated arabinoxylan and whole grain rye in subjects with the metabolic syndrome: a randomised study

after the second standard meal. Also in the entire study period, the AXRK lowered the feeling of hunger (AUC: 14852 ± 1320 mm $\times$ 0–360 min; $P = 0.005$) more than SE (AUC: 18494 ± 988 mm $\times$ 0–360 min). No significant differences were observed for fullness

response. In addition, the AXRK meal reduced the feeling of hunger compared with the control meal in subjects with MetS.

In conclusion, we demonstrated that concentrated arabinoxylan together with whole rye kernels reduced the acute glucose and insulin responses and the feeling of hunger in subjects with MetS.

→ Meals containing concentrated arabinoxylan reduce hunger and, compared to those with metabolic syndrome, also decrease acute glucose and insulin responses.

Authorised EU health claim for arabinoxylan

Nicole J. Kellow, Karen Z. Walker

Monash University, Melbourne, VIC, Australia

13.3.3 Effects on appetite regulation

In solution, arabinoxylan acts as a highly viscous fibre, which can delay gastric emptying, assisting in the control of appetite and energy intake (Torsdottir et al., 1991). The SCFAs generated by bacterial fermentation of arabinoxylans can act as ligands for free fatty acid receptor-2 (FFAR-2) and FFAR-3, which are found in tissues such as gut epithelium, adipose tissue, immune cells and skeletal muscle. Binding of SCFAs to these FFARs stimulates the release of many hormones involved in appetite regulation such as peptide YY, glucagon-like peptide-1 (GLP-1) and leptin (Chambers et al., 2015). These hormones can also influence glucose metabolism.

→ Meals containing concentrated arabinoxylan, due to their high fiber content, help regulate appetite and energy intake while stimulating the release of hormones related to appetite control.



Entanglement between Water Un-Extractable Arabinoxylan and Gliadin or Glutenins Induced a More Fragile and Soft Gluten Network Structure

glutenin. Overall, WUAX weakened the structure of the gliadins and glutenins, leading to quality deterioration of gluten.

→ WUAX (water-unextractable arabinoxylan) has been shown to reduce gluten quality, specifically by inhibiting gluten formation.

which is in harmony with the result of free SH content (Figure 1). Moreover, WUAX could interact with gluten via non-covalent bonds (hydrogen bonds and hydrophobic interaction), inhibiting the cross-linking of protein structure, thereby reducing their ductility. On the one

→ WUAX can bind to gluten through hydrogen bonding or hydrophobic interactions, interfering with the linkage of gluten proteins and potentially reducing dough elasticity.

4. Conclusions

The study showed that the free SH content of glutenins and gliadins increased after the addition of WUAX, suggesting that WUAX hindered covalent interaction between proteins resulting in a more fragile and open network structure. However,

→ When WUAX is added, gluten proteins fail to form strong bonds with each other, leading to an increase in SH (sulfhydryl) content, which inhibits gluten bonding.

FOODS

Publisher: MDPI, MDPI AG, Grosspeteranlage 5, BASEL, Switzerland, CH-4052

ISSN / eISSN: 2304-8158

Web of Science Core Collection: Science Citation Index Expanded

Additional Web of Science Indexes: Current Contents Agriculture, Biology & Environmental Sciences | Essential Science Indicators

Li, F., Li, T., Zhao, J., Fan, M., Qian, H., Li, Y., & Wang, L. (2023). Entanglement between Water Un-Extractable Arabinoxylan and Gliadin or Glutenins Induced a More Fragile and Soft Gluten Network Structure. *Foods*, 12(9), 1800. <https://doi.org/10.3390/foods12091800>

Digestion of protein and toxic gluten peptides in wheat bread, pasta and cereal and the effect of a supplemental enzyme mix

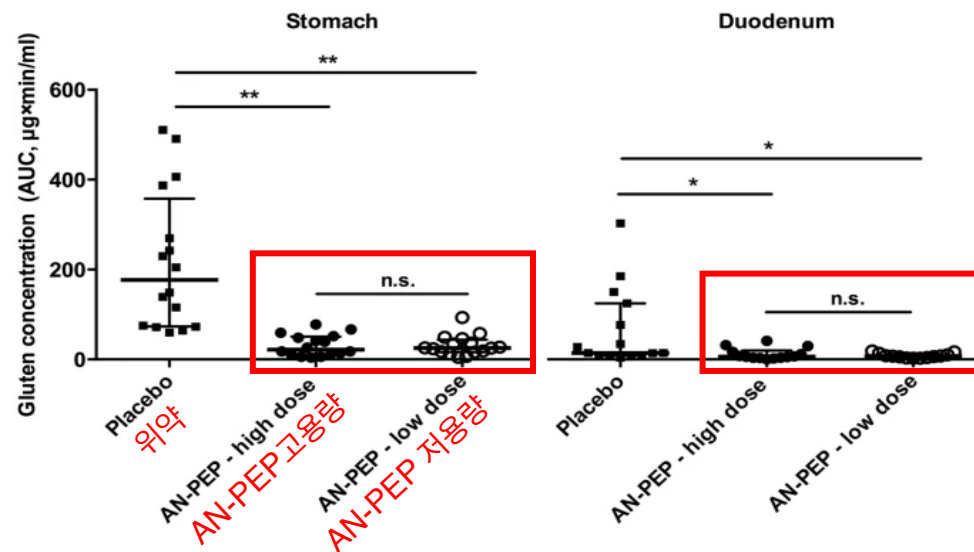
However, treatment with the enzyme supplement significantly and acutely increased protein hydrolysis and gluten degradation in the gastric stage, and this enhanced digestion was maintained into the intestinal environment. These

→ Enzyme supplementation enhances gluten degradation ability and helps maintain a healthy intestinal environment.

Randomized clinical trial: Effective gluten degradation by *Aspergillus niger*-derived enzyme in a complex meal setting

The *Aspergillus niger*-derived prolyl endoprotease (AN-PEP) has previously been shown to degrade gluten in healthy subjects when added to an intragastrically infused meal. The current study investigated

그림 1



→ When AN-PEP, a type of protease enzyme, was added to meals, it effectively degraded gluten.

AN-PEP is a type of **protease**, an enzyme that breaks down proteins. Both **high-dose and low-dose AN-PEP administration** significantly reduced gluten concentrations in the stomach and duodenum compared to placebo treatment.

Phytochemical Quantification and Total Antioxidant Capacities of Emmer (*Triticum dicoccon* Schrank) and Einkorn (*Triticum monococcum* L.) Wheat Landraces

ARDA SERPEN,[†] VURAL GÖKMEN,^{*,†} ALPTEKIN KARAGÖZ,[‡] AND HAMIT KÖKSEL[†]

two ancient wheat groups tested in this study. On average, ferulic acid content of emmer wheat samples (mean = $666.37 \pm 61.07 \mu\text{g/g}$) was about 2.1-fold higher than that of einkorn samples (mean = $311.37 \pm 80.06 \mu\text{g/g}$) where the difference was statistically significant. Meanwhile, *p*-coumaric (22.57–54.21

→ The ferulic acid content of emmer (farro) was significantly higher compared to other ancient grains.

rich in phytochemicals. The results indicated that ancient wheat varieties could meet these requirements with their high content of specific health beneficial phytochemicals such as lutein, ferulic acid, and so forth and for their high antioxidant capacities. Remarkably higher flavonoids and total antioxidant capacity were detected in emmer wheat samples, suggesting that they may have high potential utilization as a novel grain, rich in natural antioxidants. In addition, high lutein contents of einkorn samples hold the potential of developing high-lutein bakery products to considerably raise the dietary intake of carotenoids.

→ Emmer wheat has a high ferulic acid content and exhibits strong antioxidant activity.

[Amylase] Limited enzyme quantity



Understanding the gastrointestinal tract of the elderly to develop dietary solutions that prevent malnutrition

regarding the effect of advanced age on salivary flow. The latest study in this area showed a significant decline (−50%) of saliva in elderly [122] independently of medication. In

→ In elderly individuals, saliva production decreases to less than 50% of normal levels.



Rémond, D., Shahar, D. R., Gille, D., Pinto, P., Kachal, J., Peyron, M., Santos, C. N. D., Walther, B., Bordoni, A., Dupont, D., Tomás-Cobos, L., & Vergères, G. (2015). Understanding the gastrointestinal tract of the elderly to develop dietary solutions that prevent malnutrition. *Oncotarget*, 6(16), 13858–13898. <https://doi.org/10.18632/oncotarget.4030>

ENZYMES FOR HEALTH AND LONGEVITY

because of depletion. The amylase content in the young group was 30 times as great as in the old group. There were 12 young subjects, average age 25 years (21 to 31 years). The old group comprised 27 subjects with an average age of 81 years (69 to 100 years).

→ The younger group had 30 times higher amylase levels than the elderly group.
→ While the younger group could easily digest food in the mouth and stomach, the elderly group digested only about 1% of it.

SALIVARY AMYLASE UNITS IN THE TWO GROUPS

	RANGE	AVERAGE
YOUNG GROUP	2.4 to 22.2	10.15
OLD GROUP	.0.19 to 0.48	0.303

The Michael Reese investigators claim old people have a deficiency of starch digestion in the mouth and stomach. Young people can easily digest 50 grams of white bread in the mouth and stomach, while only 1 per cent of it will be digested in the mouth and stomach of old people. The authors of this



Food Enzymes for Health & Longevity: Revised and Enlarged
Paperback – January 7, 2015
by Michael Reese (Author)
ISBN-10: 0-911-111-11-1
ISBN-13: 978-0-911-111-11-1
Read with the Free App
With an expanded introduction by Vikas Kulkarni, this new, enlarged edition of the classic book contains over 400 references, 100 scientific illustrations and 100 photographs of the human body. The new edition incorporates an interview of the author by Vikas Kulkarni.

출처: Food Enzymes for Health & Longevity: Revised and Enlarged https://books.google.co.kr/books?redir_esc=y&hl=ko&id=PGJbDwAAQBAJ&q=30+times+#v=snippet&q=30%20times&f=false