



“The Nutritional Modulation Of Gut Microbiota: The Role Of Psychobiotics In Enhancing Mental Health And Cognitive Function”

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Abstract:

Barley (*Hordeum vulgare*) is **organically cultivated**, one of the variations of the **Poaceae** cereal plant of the grass family according to plant taxonomy. These nutrients collectively enhance mental health, regulate blood sugar levels, enhance digestive health and promote cardiovascular well-being. The objective of integrating psychobiotic strategies to combat depression and the neuroinflammatory disorders through nutritional analysis. The formulation of Barley drink, that have emerged as promising natural sources of **psychobiotics** - microorganisms that support mental health by modulating the **gut microbiome**.. Thus, the formulated barley based fermented beverage result in resilience and prevents from other mental disorders. Mental health and gut health are deeply interconnected, yet many young adults remain unaware of this relationship. Adolescents and young adults aged 18–25 are at a critical stage of development where stress, diet, and lifestyle choices significantly impact both their mental well-being and digestive health. The findings aim to bridge gaps in awareness, providing insights into how education and dietary interventions can support better mental and emotional well-being in this age group

Keywords : barley, psychobiotics, mental health, gut microbiome, lifestyle, awareness

1. Introduction:

The relationship between dietary habits and mental health has attracted increasing attention, particularly as research sheds light on the profound interplay between gut health and brain function. This evolving field has introduced psychobiotics—a specific category of probiotics and prebiotics capable of enhancing mental well-being—as a promising intervention for conditions such as anxiety, depression, and other psychological disorders. These bioactive agents operate by modulating gut microbial ecosystems, supporting the gut-brain communication network, and fostering neurochemical equilibrium through pathways that remain the subject of ongoing investigation.

Psychobiotics exert their influence by regulating the synthesis of key neurotransmitters such as serotonin, dopamine, and gamma-aminobutyric acid (GABA), which are essential for maintaining mood stability, cognitive processes, and emotional resilience. Additionally, they play a pivotal role in immune modulation by mitigating systemic inflammation—a recognized contributor to neuroinflammation and mental health challenges.

By cultivating a balanced and robust gut microbiome, psychobiotics hold the potential to alleviate symptoms of anxiety and depression while complementing conventional treatments, potentially reducing dependence on pharmaceuticals and their associated side effects.

Barley (*Hordeum vulgare*), an ancient grain with a longstanding history in human diets, has recently garnered renewed attention for its remarkable nutritional composition and functional attributes. Among its most notable features is its abundance of beta-glucans, as it a type of soluble fiber with well-established prebiotic properties. Beta-glucans act as a food source for good gut bacteria, promoting their proliferation and metabolic activity. This process yields short-chain fatty acids (SCFAs) such as butyrate, propionate, and acetate, which play integral roles in maintaining gut integrity, suppressing inflammation, and providing an energy source for colon cells. Barley's prebiotic potential extends beyond its role in gut health to influence the gut-brain axis. By fostering the growth of beneficial gut microbes like *Bifidobacterium* and *Lactobacillus* species, barley-derived beta-glucans enhance the production of neuroactive molecules while attenuating inflammatory markers implicated in mood disorders.

Additionally, barley's rich profile of B-complex vitamins, magnesium, and polyphenols contributes to cognitive enhancement and stress regulation. Incorporating barley into the diet offers a dual advantage: promoting microbial diversity and resilience while conferring systemic health benefits that underpin mental well-being. Emerging research suggests that the combined use of barley with psychobiotics could create synergistic effects by intensifying the metabolism of barley's fibers into SCFAs, further amplifying its anti-inflammatory and neuroprotective outcomes. This expanding body of evidence positions barley not merely as a nutrient-dense grain but as a cornerstone for integrative dietary strategies aimed at addressing mental health disorders. However, further exploration, particularly through human clinical trials, is necessary to fully elucidate the underlying mechanisms and unlock the therapeutic potential of barley and psychobiotic synergy in managing mental health conditions.

2. Objectives:

- Evaluated people from the age group of 18 - 25 to analyse their mental and gut health and also their knowledge about Psychobiotics.
- Outcomes are estimated through data collection and statistical analysis
- Establish Barley-infused product as a Dietary Intervention for Mental Health

3. Methodology:

The methodology of the study conducts based on the “ **Assessing The Mental Health Of Adolescents At The Age Group Of 18-23 And Their Awareness About Psychobiotics**”

3.1 Methods

3.3.1. Selection of Participants

The online survey will target participants aged **18 to 25** , who have **mild-to-moderate mental health** concerns (anxiety, depression, or stress), their awareness about the psychobiotics and the use of barley in routine.

3.3.2. Data Collection

With the rising popularity of questionnaire-based research, it is evident that careful consideration of various factors is essential. This attention ensures that the data collected is both effective and usable, enabling us to gather practical and applicable insights.(**Marshall, G. 2005**). 115 samples were selected among the adolescent group of different gender belonging to the age group of 18-25 were selected in this study.

3.3.3. Tools used for the Study

Questionnaire was formulated to collect the data regarding:

- ⇒ Demographics (Name, Age, Gender)
- ⇒ Dietary Habits (Frequency of Cereals, Fibre rich foods, Prebiotics)
- ⇒ Gut Health (Feeling of satiety, hunger frequency, elimination process)
- ⇒ Mental Health (anxiety, depression and their frequency)
- ⇒ Knowledge on Psychobiotics (probiotics on mental health)

3.3.4. Data Analysis

- ⇒ **Stratified Analysis** - Stratified randomization is a two-step process used in clinical trials. First, samples of different age groups (strata) based on certain clinical features are analyzed. This approach helps ensure that the results are more accurate and relevant to

each specific group. By taking these factors into account, researchers can better assess the effectiveness of treatments across diverse patient populations..(Kernan, W. N. *et al.*, 1999)

⇒ **Descriptive Analysis** - Descriptive analysis started with foods and beverages but has expanded to cover a wide variety of products, from home and personal care . It's a versatile tool used throughout the product lifecycle, aiding in market mapping, product development, value optimization, and quality control and assurance. By applying descriptive analysis, we can better understand and improve products at every stage of their journey.(**Kemp, S. E., *et al* 2018**)

3.3.5 Hypothesis

Levels of mental health disorders are assessed by various factors, and dietary interventions are crafted to address these issues. By tailoring nutritional strategies, we aim to support and improve mental well-being. This approach recognizes the powerful connection between diet and mental health, emphasizing the importance of what we eat in managing and potentially alleviating mental health challenges.

3.3.6 ANALYSIS OF NUTRIENT CONTENT OF BARLEY POWDER (*Hordeum vulgure.L*)

The nutrient content in the barley powder was subjected and the presence of Vitamin-B complex was analyzed.

In this methodology, the B-complex vitamins are typically dissolved in an appropriate solvent, such as an aqueous buffer or acidic medium, to enhance their solubility and spectral response. The sample is then scanned over a wavelength range (e.g., 300–500 nm) to detect absorption peaks corresponding to specific vitamins.

3.3.7.ANALYSIS OF ANTIOXIDANT ACTIVITY OF BARLEY POWDER

The barley powder subjected to antioxidant activity was calculated using DPPH method.

This methodology involves the preparation of a DPPH solution in methanol, followed by its reaction with Barley powder extract at varying concentrations. The absorbance of the resulting mixture is measured to evaluate the radical scavenging activity. Ascorbic acid serves as a reference standard to compare the antioxidant efficacy of Barley powder. The findings from this study will provide valuable insights into the potential health benefits and functional properties of this indigenous rice variety.

The procedure for the estimation of Total antioxidant activity is given in the Appendix 3.

3.3 ANALYSIS OF ANTI-BACTERIAL ACTIVITY OF BARLEY POWDER

The Barley powder was analyzed with the Anti-Bacterial Method through AGAR WELL DIFFUSION METHOD with both Nutrient broth and Nutrient Agar medium.

Shelf life analysis is a crucial aspect of food quality assessment, determining the microbial stability and safety of food products during storage Barley powder is evaluated for bacterial contamination to ensure its storage suitability and potential spoilage risks. Microbial contamination in rice is primarily influenced by environmental factors such as temperature, humidity, and storage conditions. This study employs microbiological techniques to monitor bacterial growth, which can impact the rice's longevity and consumer safety.

3 Result & Discussion:

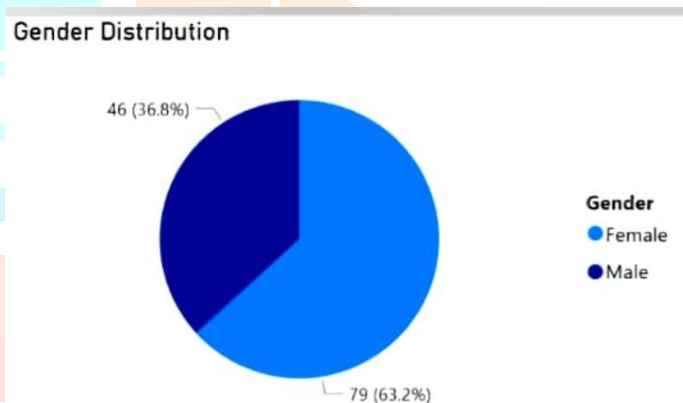


Figure no 1 on Gender distribution

The target group of participants from the age of 18-25 and the contribution of the female(63.2%) are higher comparatively to the men(36.8%).

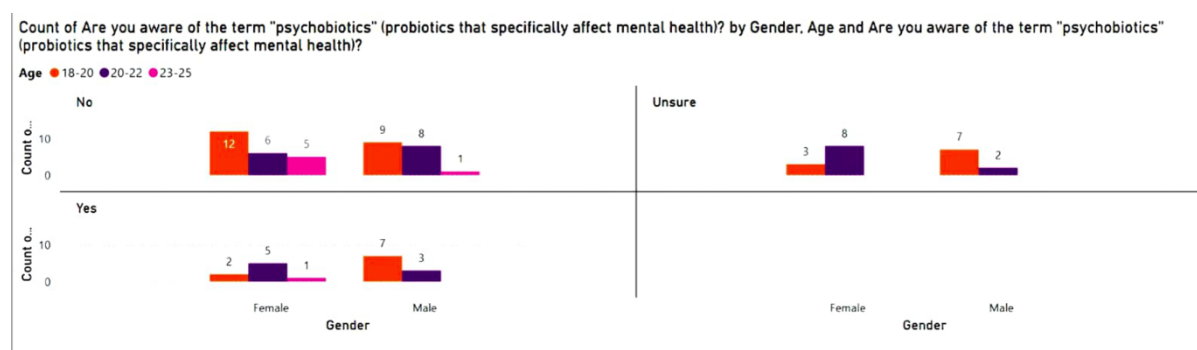


Figure no 2 on count by people on age

The age group of the participants are classified as three groups as 18-20, 21-22, 23-25

Count of People by Gender and Age

Age ● 18-20 ● 20-22 ● 23-25

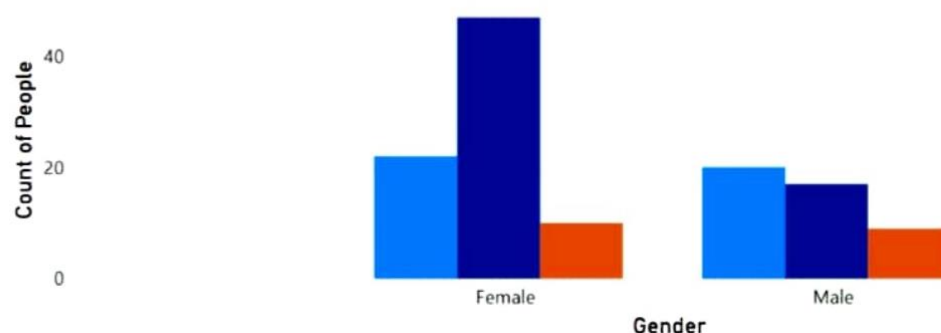


Figure 3 on the awareness of students on the term psychobiotics

The awareness about psychobiotics among the groups are being less and the role of psychobiotics in mental health are analysed. It found that there is no awareness about the psychobiotics and its effect on health.

NUTRIENT COMPOSITION OF BARLEY DRINK POWDER

4.1.1 Nutrient composition of Barley Drink Powder is given in the table-1

TABLE-1

Barley Drink Powder	Nutritive value per (100g)	
Barley Drink Powder	Energy	204 kcal
	Protein	4.27g
	Fat	4.79g
	Carbohydrate	35.87g
	Calcium	81.47mg
	Fiber	4.86g
	Iron	2.01mg
	Sodium	7.55mg

The nutrient composition of the barley drink powder is given in the above table 1. It contains energy content of 204 kcal, protein content of 4.27 g, fat content of 4.79g, carbohydrate content of 35.87g and the calcium content of 81.47mg with the fiber content of 4.86g.

4.2 VITAMIN B COMPLEX PRESENCE THROUGH HPLC METHOD**TABLE 2****THE EXTRACTION TABLE AND PRESENCE OF VITAMIN B COMPLEX**

	RT	Area	% Area	Height
1	2.107	1942628	45.51	132783
2	2.282	86075	2.02	63413
3	2.424	2104591	49.31	73940
4	4.005	135034	3.16	6626

The data was collected and processed through identify the presence of B-complex Vitamins in the Barley Drink Powder. The preparation: 1 mg/ml concentration of the compound was taken and dissolved with HPLC-grade methanol and resulted a peak value at the RT of 2.107: Area of 1942628: Area% of 45. 51: and the height of 132783.

4.3 ANTIOXIDANT ACTIVITY OF THE BARLEY DRINK POWDER**TABLE-3****TOTAL ANTIOXIDANT ACTIVITY OF THE
BARLEY DRINK POWDER (100g)**

OD Value at 517 nm

Control Mean OD value: 1.224

S.NO	Test sample concentration (µg/ml)	OD Value at 517 nm (in triplicates)		
1.	control	1.223	1.232	1.218
2.	500 µg/ml	0.394	0.349	0.342
3.	250 µg/ml	0.568	0.520	0.588
4.	100 µg/ml	0.659	0.664	0.694
5.	50 µg/ml	1.017	1.013	1.088
6.	10 µg/ml	1.112	1.119	1.115
7.	Ascorbic acid	0.078	0.063	0.068

The above table -3 depicts the antioxidant activity of Barley Drink Powder.

The antioxidant activity of the Barley Drink Powder per 100g for 500 µg of concentration of sample is 1.223,1.232, and 1.218 and for the ascorbic acid the values are 0.078, 0.063 and 0.068

SENSORY EVALUATION OF BLACK CUMIN SEED BASED RECIPES:

A trained panel member group consisting of 25 members was given the barley drink powder for evaluation of organoleptic viz. colour, flavour, taste, texture, appearance and over all acceptability. Using a 9-point hedonic scale it was served to the panel members on the day of preparation. The average score were recorded by the panel members and the same is presented and discussed in the following table 4.

4.3 MEAN SCORE OF THE ACCEPTABILITY OF BARLEY DRINK POWDER**TABLE-4****MEAN SCORE OF THE ACCEPTABILITY OF THE BARLEY DRINK POWDER**

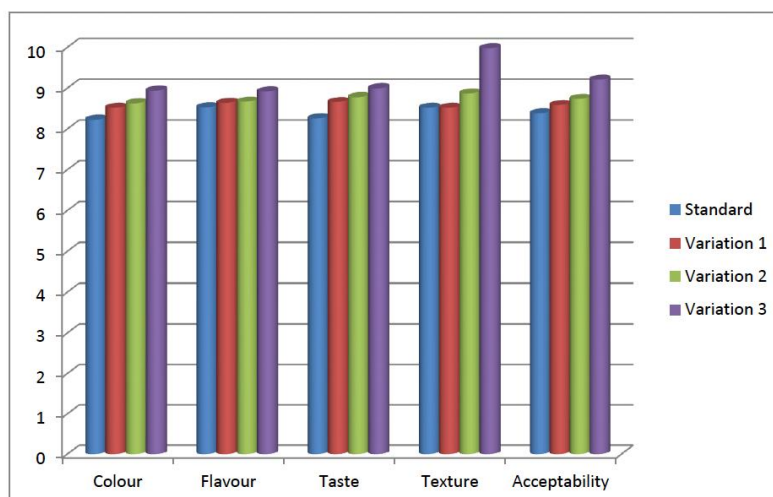
SAMPLE	MEAN $\pm$ STANDARD DEVIATION
Standard	7.9 $\pm$ 0.79
Variation -1	8 $\pm$ 0.7
Variation -2	7.4 $\pm$ 0.83
Variation -3	9 $\pm$ 0

V1 – Variation 2%, V2 – Variation 1%, V3 – Variation 3%

The overall acceptability of the Barly Drink Powder revealed that the variation, V3 has got the highest score of 9. The least accepted sample was the V2 and V1 with mean score of 7.4 and 8 respectively. The mean score of the Variation 3 is higher than all the other variations.

FIGURE – 1

MEAN SCORE OF THE SENSORY EVALUATION FOR BARLEY DRINK



The mean scores of the sensory evaluation showed that the barley drink powder were within acceptable range, while the barley drink from the variation 3 had a better Colour (8.92 ± 0.14), Flavour (8.92 ± 0.14), Taste (8.96 ± 0.07), Texture (8.92 ± 0.14) and the overall acceptability (9 ± 0) among all the other variations. It is clear that the recipe with the incorporation of black cumin powder at 3% level had the highest overall acceptability.

4 Conclusion:

- The results of the present study have brought out beneficial effect of *Hordeum vulgure*. It could be concluded from the present study that the value addition of Barley Drink Powder helped to enhance the mental health, increase the nutrient content, antioxidant activity and presence of B-complex vitamins along with the anti-bacterial activity through the agar well diffusion method. In respect to the sensory evaluation from all three variations of recipes were in acceptable range and maximum score was seen in sample 3 as compared with the control recipe. The **test sample has antioxidant activity**, as it scavenges **free radicals** and **reduces absorbance at 517 nm**. If this is a bacterial growth assay, the lower OD suggests the test sample **inhibits growth at higher concentrations**. The test sample BT exhibits antibacterial activity against both **S.aureus and E.coli**, but only at **500 µg/ml**. No inhibitory effect was observed at lower concentrations. The chromatogram shows multiple peaks, meaning the sample contains at least four distinct

components. The main peak at **2.107 min** could be the target compound if this is a purity check.

If this is a quantitative analysis, the area under the peaks represents the concentration of each compound.

- Hence from the results The study highlights psychobiotics in mental health by modulating the gut-brain axis. The test sample BT shows antioxidant and antibacterial activity (*S. aureus*, *E. coli*) at 500 µg/ml. Chromatography reveals four compounds, with RT 2.107 min as a potential target. Thus the study suggests that *Hordeum vulgure* has the applications in mental health, antimicrobials, and antioxidants.

5.7.1 Recommendation based on this study:

- In future, it can be added to formulate value added foods and can be used as an ingredient along with such type of product development.
- In further intervention studies can be carried out on quantity of the *Hordeum vulgure*'s B-complex vitamins and the antioxidant activity.
- It can be utilized for entrepreneurial activity.
- The results of the study would have way to create awareness to about the increase in the mental health disorders among the adolescents.

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