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# The Effect of Wheat Germ Consumption on Tinnitus

## Buğday Ruşeymi Tüketiminin Tinnitus Üzerine Etkisi

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**ABSTRACT Objective:** The objective of this study is to investigate the effect of consumption of wheat germ on the anthropometric measurements, severity of tinnitus and blood biochemical parameters in patients with tinnitus. **Material and Methods:** The study was performed on 40 adult patients between the ages of 19-65, who have had tinnitus complaints for at least one month between October 2014 and April 2015. Fifty g of wheat germ was added to the diet of 20 randomly selected tinnitus patients for 1 month (study group) while 20 tinnitus patients made no change to their diet (control group). None of the patients received medical treatment. A Tinnitus Disability Questionnaire (TDQ), Visual Analog Scale (VAS) and Beck Depression Inventory were applied to the patients. Biochemical parameters were retrieved from their records at the beginning and end of the study. **Results:** As a result, a decrease was observed in VAS and TDQ scores of the patients in the study group at the end of the study compared to the beginning of the study (p=0.011, p=0.048), in the control group, only TDQ score decreased (p=0.016). No difference was found between VAS and TDQ at the beginning and at the end. Also in the study group; a significant negative correlation was found between the change in VAS and TDQ scales and dietary protein intake (r=-0.599, p=0.005; r=-0.468, p=0.038), and a positive correlation was found between soluble fiber intake (r=0.478, p=0.033; r=0.638, p=0.002). **Conclusion:** When the decrease in VAS and TDQ scores of tinnitus patients who are not trained about nutrition is evaluated, it can contribute to the decrease in the severity of rhinney tinnitus, which is rich in some minerals and dietary fiber added to their diet. In addition, the closer follow-up of the patients included in the study may have provided psychological support and decreased the perception of tinnitus. Further studies are needed in this regard.

**Keywords:** Tinnitus; nutrition therapy; whole grains; wheat germ

**ÖZET Amaç:** Bu çalışmanın amacı, buğday ruşeymi tüketiminin antropometrik ölçümler, tinnitus şiddeti ve biyokimyasal parametreler üzerindeki etkisini araştırmaktır. **Gereç ve Yöntemler:** Çalışma, Ekim 2014 ve Nisan 2015 tarihleri arasında, 19-65 yaş arası, en az 1 aydır tinnitus şikâyeti süren 40 erişkin hasta üzerinde yapılmıştır. Rastgele seçilen 20 tinnitus hastasının diyetine 1 ay boyunca 50 g buğday ruşeymi eklenirken (çalışma grubu), diyetinde herhangi bir değişiklik yapılmayan 20 tinnituslu hasta kontrol grubu olarak alınmıştır. Hastaların hiçbiri tıbbi bir tedavi almamıştır. Hastalara, Tinnitus Engellilik Anketi (TEA) Ölçeği, Vizüel Analog Skala (VAS) ve Beck Depresyon Ölçeği uygulanmıştır. Çalışma başlangıcı ve sonunda biyokimyasal parametreler, hasta dosyalarından alınmıştır. **Bulgular:** Çalışma sonunda, çalışma grubundaki hastaların VAS ve TEA skorlarında, çalışmanın başlangıcına göre azalma gözlenirken (p=0,011, p=0,048), kontrol grubunda yalnızca TEA skorunda azalma görülmüştür (p=0,016). Gruplar arası karşılaştırmalarda, VAS ve TEA arasında başlangıçta ve bitişte fark bulunmamıştır. Ayrıca çalışma grubunda; VAS ve TEA ölçeklerinde gözlenen değişiklik ile diyet proteini alımı arasında negatif (r=-0,599, p=0,005; r=-0,468, p=0,038), çözünür lif alımı arasında pozitif (r=0,478, p=0,033; r=0,638, p=0,002) yönlü bir ilişki bulunmuştur. **Sonuç:** Beslenme hakkında herhangi bir eğitim verilmeyen tinnitus hastalarında, VAS ve TEA skorlarındaki azalma değerlen-dirildiğinde, beslenmelerine eklenen bazı mineraller ve diyet lifi açısından zengin olan ruşeym, tinnitus şiddetinde azalmaya katkıda bulunabilir. Bununla birlikte çalışmaya alınan hastaların daha yakın takip edilmiş olması da psikolojik destek sağlayarak tinnitusun algılanmasında azalma sağlamış olabilir. Bu konuda daha ileri çalışmalara ihtiyaç vardır.

**Anahtar Kelimeler:** Tinnitus; beslenme tedavisi; tam tahıl; buğday ruşeymi

Tinnitus is sounds that can be continuous or intermittent, felt without an external sound source. They consist of irregular sounds at various frequencies and have no meaning.[1,2] The condition is observed in 20.7-24.2% of the general population and increases with age.[3] It is primarily observed in individuals between the ages of 40-80.[4,5] Tinnitus, which is one of the most common symptoms of the hearing system, can also be a sign of various diseases such as aneurysm and acoustic neurinoma.[6-9] Additionally, al-

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lergies, high or low blood pressure, diabetes, thyroid problems and obesity can cause tinnitus.[10,11] Prior research studies have shown that metabolic diseases such as diabetes mellitus (DM), hypertension and hyperlipidemia and deficiencies of some vitamin and mineral such as vitamin $B_{12}$, iron (Fe) and zinc (Zn) are common in patients with tinnitus.[11-16] These studies demonstrate that nutrients, nutrition and dietary modifications are important in the treatment of tinnitus. Herbal supplements such as vitamin and mineral supplements, ginkgo biloba extract are also tried in the treatment of tinnitus.[17,18]

Wheat germ contains B vitamins, vitamin E, minerals (Ca, Mg, K, P, Na and Fe), phytochemicals, antioxidants (ferulic acid, coumaric acid, flavonoids) and unsaturated fats (n-3 and n-6 fatty acids).[19] This study was planned and conducted in order to investigate the effects of the addition of wheat germ with high nutritional value on the degree of tinnitus and biochemical parameters.

## MATERIAL AND METHODS

Randomized, controlled and sequentially controlled prospective study was conducted between October 2014 and April 2015 with volunteer tinnitus patients who presented to the Department of Otorhinolaryngology (ENT), Gülhane Military Hospital. The study was approved by the Ethics Committee of Gülhane Military Medical School 2014/05 (KAEK-14016) number. Volunteer individuals aged 19-65 years who had been suffering from tinnitus for at least one month and had not received any treatment for tinnitus were included in the study. Patients who are diagnosed with acute and objective tinnitus, who use medication that can cause tinnitus, have a body mass index (BMI) ≥30 kg/m$^2$, take any dietary supplements, those with chronic diseases such as hypertension, DM, liver and kidney failure, gluten enteropathy, dyslipidemia, neuropsychiatric disease, menstrual disease, patients who have previously had ear surgery, chronic otitis, chronic rhinosinusitis, acoustic tumor, otosclerosis, temporomandibular joint dysfunction, head trauma in the past week, and chronic alcohol use were excluded.

At the beginning of the study, each patient was asked to complete the questionnaire about sociodemographic characteristics and nutritional habits via a face to face interview method. Patients were also asked to provide a 3-day food consumption diary at the beginning and end of the intervention. Anthropometric measurements (body weight, height, waist circumference and neck circumference) were taken by the researcher and waist/height ratio and BMI were calculated. The Tinnitus Disability Questionnaire (TDQ) Scale and the Visual Analog Scale (VAS) were used to assess the severity of tinnitus, and the Beck Depression Inventory was used to measure the depression and anxiety.[20,21] Turkish validity and reliability study of TDQ was conducted by Aksoy et al. in 2006.[22] Fasting blood glucose, total cholesterol, triglyceride, fasting insulin level, serum folate, Mg, Zn, Fe, ferritin, vitamin $B_{12}$, vitamin D and hematological values (hemoglobin and hematocrit) were evaluated before and at the end of the study. The patients in the study group were given 50 g of wheat germ per day by the researcher at the beginning of the study and they were asked to consume it by adding into yoghurt or salad every day without disturbing their usual eating habits. Four week later, same assessments were undertaken on patients in both groups i.e. completion of TDQ and VAS, repetition of biochemical measurements and anthropometric measurements, and the last 3 days food consumption information was obtained. No additional medical treatment and/or cognitive therapy was applied to the patients during this period.

Dietary energy and nutrients were analysed using Computer Aided Nutrition Program [Nutrition Information Systems Package Program (BEBIS)] developed for Turkey. The calculated energy and nutrient data were compared with the Dietary Reference Intake. SPSS 15.0 statistical program was used for statistical evaluation in a Windows operating system. The suitability of the parameters to normal distribution was evaluated with the Shapiro-Wilk test. In the comparison, chi-square test ($\chi^2$), Fisher-exact chi-square test and continuity (Yates) corrected chi-square test were used. Pearson correlation analysis was used to examine the relationships among parameters that showed normal distribution, and Spearman's rho correlation analysis was used to examine the relationship between parameters that did not show normal distri-

bution. Significance level was accepted as $p<0.05$ in all statistical analyses.

The study was conducted in accordance with the Helsinki Declaration principles.

## RESULTS

The sample of the study was calculated over the number of patients who applied to the ENT clinic with a complaint of tinnitus for 6 months and who met the inclusion criteria. This study included 20 patients in the study group, with a mean age of 45.9±8.44 years (age range: 30 to 59 years), 14 (70%) males and 6 (30%) females and 20 patients in the control group, with a mean age of 41.5±11.83 years (age range: 20 to 60 years), 14 (70%) male and 6 (30%) female. The two groups were similar in terms of sociodemographic characteristics. A significant difference was found only in waist/height ratios of male patients in the study and control groups. The mean waist/height ratio of the male patients in the study group was significantly higher than the control at the beginning of the study (p=0.049) (Table 1). There was no statistically significant difference between the anthropo-

**TABLE 1:** Anthropometric measurements of the patients obtained at the beginning and end of the study.

| | | Study group | Control group | |
|---|---|---|---|---|
| **Male (n=14)** | | **x±SD** | x±SD | **p value** |
| Body weight (kg) | Beginning | 83.89±9.98 | 81.86±7.73 | 10.552 |
| | End | 84.01±10.19 | 81.79±7.79 | 10.524 |
| | [2]p value | 0.758 | 0.684 | |
| BMI (kg/m$^2$) | Beginning | 28.03±3.15 | 26.84±2.26 | 10.263 |
| | End | 28.18±3.5 | 26.88±2.37 | 10.264 |
| | [2]p value | 0.371 | 0.570 | |
| Waist circumference (cm) | Beginning | 103.07±7.44 | 98.36±5.36 | 10.065 |
| | End | 102.36±7.17 | 98.21±5.21 | 10.092 |
| | [2]p value | 0.106 | 0.547 | |
| Neck circumference (cm) | Beginning | 40.79±2.46 | 39.64±2.06 | 10.194 |
| | End | 40.46±2.19 | 39.57±2.03 | 10.273 |
| | [2]p value | 0.069 | 0.336 | |
| Waist/height ratio | Beginning | 0.6±0.05 | 0.56±0.03 | 10.049* |
| | End | 0.59±0.05 | 0.56±0.03 | 10.073 |
| | [2]p value | 0.109 | 0.556 | |
| **Female (n=6)** | | | | |
| Body weight (kg) | | | | |
| | Beginning | 59.33±13.89 (63) | 72.3±13.05 (69) | 30.148 |
| | End | 59.45±12.94 (62.6) | 72.33±12.97 (70) | 30.147 |
| | [4]p value | 0.750 | 0.891 | |
| BMI (kg/m$^2$) | Beginning | 23.15±4.73 (23.7) | 25.85±3 (25.85) | 30.297 |
| | End | 23.26±4.37 (23.71) | 25.93±3.25 (25.9) | 30.378 |
| | [4]p value | 0.463 | 0.600 | |
| Waist circumference (cm) | Beginning | 85.83±12.53 (86.5) | 92.5±9.05 (95.5) | 30.260 |
| | End | 85.5±11.78 (86.5) | 92.5±9.16 (95.5) | 30.229 |
| | [4]p value | 0.480 | 1.000 | |
| Neck circumference (cm) | Beginning | 33.67±1.97 (34.5) | 32.5±2.17 (32) | 30.404 |
| | End | 33.5±1.97 (34) | 32.5±2.17 (32) | 30.450 |
| | [4]p value | 0.317 | 1.000 | |
| Waist/height ratio | Beginning | 0.54±0.07 (0.53) | 0.56±0.05 (0.58) | 30.423 |
| | End | 0.54±0.07 (0.53) | 0.56±0.06 (0.58) | 30.631 |
| | [4]p value | 0.893 | 0.655 | |

SD: Standard deviation; BMI: Body mass index; [1]Student t-test; [2]Paired sample t-test; [3]Mann-Whitney U test; [4]Wilcoxon signed-rank test; *p<0.05.

metric measurements of the female patients in the study and control groups at the beginning and at the end of the study (p>0.05) (Table 1).

According to the data obtained from the food consumption diary, for all patients there was no significant change in the intake of protein and fat at the end of the study. On the other hand at the end of the study, dietary fiber, magnesium, phosphorus and iron intake of the male patients in the study group (p=0.003, p=0.038, p=0.001, p=0.033) (Table 2) and the phosphorus and iron intake of the female patients in the study group were statistically higher than at the beginning of the study (p=0.043; p=0.028) (Table 2). The male patients in the control group had higher CHO intake than study group at the beginning of the study, energy and CHO intake was higher than the study group at the end of the study (p=0.028; p=0.007; p=0.001) (Table 2). In addition, at the be-

**TABLE 2:** Daily energy and nutrient intake of patients at the beginning and end of the study.

| **Male** | | **Beginning** | **End** | |
|---|---|---|---|---|
| | | **x±SD** | **x±SD** | **[1]p value** |
| Energy (kcal) | Study group | 1,601.6±451.89 | 1,468.7±480.62 | 0.358 |
| | Control group | 1,783.4±418.51 | 1,909.8±298.48 | 0.347 |
| | [2]p value | 0.279 | 0.007** | |
| CHO (g) | Study group | 153.5±50.24 | 150.6±40.28 | 0.559 |
| | Control group | 197.0±48.68 | 215.9±44.36 | 0.326 |
| | [2]p value | 0.028* | 0.001** | |
| CHO, (energy %) | Study group | 39.7±7.11 | 39.7±7.06 | 1.000 |
| | Control group | 45.9±6.94 | 45.7±6.39 | 0.671 |
| | [2]p value | 0.029* | 0.026* | |
| Diet fiber (g) | Study group | 17.9±7.26 | 20.2±6.01 | 0.033* |
| | Control group | 16.2±4.56 | 19.1±5.56 | 0.114 |
| | [2]p value | 0.459 | 0.631 | |
| | [2]p value | 0.606 | 0.429 | |
| Magnesium (mg) | Study group | 222.7±71.86 | 240.9±68.37 | 0.003** |
| | Control group | 217.5±70.59 | 237.3±71.81 | 0.397 |
| | [2]p value | 0.848 | 0.893 | |
| Phosphorus (mg) | Study group | 984.1±276.53 | 1,066.4±225.58 | 0.038* |
| | Control group | 1,014.7±314.84 | 1,036.2±294.31 | 0.827 |
| | [2]p value | 0.787 | 0.763 | |
| Iron (mg) | Study group | 9.8±2.90 | 12.5±3.60 | 0.001** |
| | Control group | 9.6±2.25 | 11.1±3.20 | 0.048* |
| | [2]p value | 0.788 | 0.277 | |
| **Female** | | | | [3]p value |
| CHO (g) | Study group | 149.8±48.24 (161.2) | 145.3±48.83 (152.89) | 0.715 |
| | Control group | 205.1±36.75 (201.73) | 180.6±16.38 (180.37) | 0.917 |
| | [4]p value | 0.037* | 0.262 | |
| CHO, (energy %) | Study group | 38.7±4.13 (39.5) | 38.7±3.39 (38.5) | 0.317 |
| | Control group | 45.7±4.68 (44.0) | 46.2±4.36 (45) | 0.655 |
| | [4]p value | 0.013* | 0.008** | |
| Linoleic acid (g) | Study group | 17.1±5.66 (17.71) | 16.6±5.40 (15.92) | 0.180 |
| | Control group | 26.4±11.30 (24.22) | 22.0±5.16 (22.62) | 0.317 |
| | [4]p value | 0.037* | 0.109 | |
| Phosphorus (mg) | Study group | 1,008.4±311.96 (1,081.62) | 1,108.1±278.64 (1,115.91) | 0.043* |
| | Control group | 1,075.9±278.72 (1,057.26) | 903.3±227.99 (1,024.59) | 0.249 |
| | [2]p value | 1.000 | 0.150 | |
| Iron (mg) | Study group | 9.9±3.09 (10.52) | 12.4±2.40 (12.41) | 0.028* |
| | Control group | 9.7±3.01 (10.64) | 9.1±2.80 (8.76) | 0.917 |
| | [2]p value | 0.873 | 0.055 | |

SD: Standard deviation; CHO: Carbohydrate; [1]Paired sample t-test; [2]Student t-test; [3]Wilcoxon signed-rank test; [4]Mann-Whitney U test; *p<0.05; **p<0.01.

ginning of the study, CHO intake and linoleic acid intake were higher in female patients in the control group than study group (p=0.013; p=0.037) (Table 2). There was no significant difference in vitamin intake between the beginning and end of the study in all patients in both groups (p>0.05) (Table 2).

At the beginning of the study, no significant difference was found between the biochemical values of patients in both groups (p>0.05) (Table 3). At the end of the study; serum zinc and vitamin D values were higher in the study group than the control group (p<0.05), and serum folate value was significantly lower (p<0.05) (Table 3).

There was no significant difference between VAS, TDQ and Beck scores between the two groups both at the beginning and end of the study (p=0.924; p=0.958; p=0.542) (Table 4). On the other hand, a decrease was observed in VAS and TDQ scores of the patients in the study group at the end of the study compared to the beginning of the study (p=0.011;

**TABLE 3:** Biochemical measurements of patients at the beginning and end of the study.

| | | Beginning x±SD | End x±SD | [1]p value |
|---|---|---|---|---|
| Fasting blood glucose (mg/dL) | Study group | 98.6±11.85 | 95.1±9.16 | 0.231 |
| | Control group | 94.0±13.65 | 91.8±13.82 | 0.229 |
| | [2]p value | 0.262 | 0.386 | |
| Fasting insulin (µIU/mL) | Study group | 9.5±6.34 | 10.1±3.82 | 0.643 |
| | Control group | 11.6±5.14 | 11.4±5.06 | 0.812 |
| | [2]p value | 0.251 | 0.365 | |
| Total cholesterol (mg/dL) | Study group | 203.2±32.76 | 204.4±35.09 | 0.838 |
| | Control group | 183.6±29.46 | 188.1±29.73 | 0.099 |
| | [2]p value | 0.055 | 0.122 | |
| Triglycerides (mg/dL) | Study group | 148.3±76.20 | 151.6±88.91 | 0.786 |
| | Control group | 125.7±57.91 | 125.9±48.0 | 0.982 |
| | [2]p value | 0.298 | 0.263 | |
| Iron (mcg/dL) | Study group | 87.3±41.43 | 81.6±29.94 | 0.463 |
| | Control group | 89.7±31.07 | 93.9±28.11 | 0.439 |
| | [2]p value | 0.837 | 0.187 | |
| Ferritin (ng/mL) | Study group | 70.4±63.33 | 64.6±58.47 | 0.436 |
| | Control group | 69.9±53.13 | 68.4±49.20 | 0.833 |
| | [2]p value | 0.979 | 0.825 | |
| Vitamin B12 (pg/mL) | Study group | 381.1±232.13 | 354.9±180.05 | 0.311 |
| | Control group | 339.1±214.38 | 405.6±338.31 | 0.135 |
| | [2]p value | 0.556 | 0.557 | |
| Folate (ng/mL) | Study group | 11.6±5.54 | 9.6±3.14 | 0.047* |
| | Control group | 10.8±5.17 | 10.9±3.53 | 0.863 |
| | [2]p value | 0.629 | 0.207 | |
| Magnesium (mg/dL) | Study group | 2.1±0.23 | 2.1±0.27 | 0.904 |
| | Control group | 2.0±0.11 | 2.1±0.30 | 0.519 |
| | [2]p value | 0.449 | 0.979 | |
| Zinc (mcg/dL) | Study group | 89.6±32.38 | 92.7±22.56 | 0.609 |
| | Control group | 80.9±25.84 | 77.3±13.28 | 0.480 |
| | [2]p value | 0.353 | 0.012* | |
| Vitamin D (ug/L) | Study group | 25.5±9.67 | 28.8±8.86 | 0.110 |
| | Control group | 22.5±10.05 | 20.6±9.31 | 0.231 |
| | [2]p value | 0.333 | 0.007** | |
| Hemoglobin (g/dL) | Study group | 14.8±1.26 | 14.6±1.45 | 0.314 |
| | Control group | 14.7±1.08 | 14.8±1.07 | 0.700 |
| | [2]p value | 0.944 | 0.605 | |
| Hematocrit (%) | Study group | 44.4±4.72 | 43.3±3.52 | 0.129 |
| | Control group | 44.6±3.09 | 42.9±9.42 | 0.451 |
| | [2]p value | 0.911 | 0.888 | |

SD: Standard deviation; [1]Student t-test; [2]Paired sample t-test; *p<0.05; **p<0.01.

**TABLE 4:** Patients' VAS, TDQ scores and Beck Depression Inventory scores.

| | | Beginning x±SD (median) | End x±SD (median) | p value |
|---|---|---|---|---|
| VAS | Study group | 5.6±2.18 (5) | 4.2±2.28 (4.5) | 10.011* |
| | Control group | 5.6±2.31 (5.5) | 4.9±2.38 (5) | 10.218 |
| | [2]p value | 0.924 | 0.318 | |
| TDQ | Study group | 39.5±22.82 | 33.1±19.31 | 30.048* |
| | Control group | 39.9±24.40 | 35.4±23.53 | 30.016* |
| | [4]p value | 0.958 | 0.737 | |
| Beck | Study group | 9.6±9.34 (7.5) | 8.6±7.96 (6) | 10.131 |
| | Control group | 8.9±9.38 (5.5) | 7.4±8.26 (3) | 10.160 |
| | [2]p value | 0.542 | 0.480 | |

VAS: Visual analog scale; TDQ: Tinnitus Disability Questionnaire; [1]Wilcoxon sign test; [2]Mann-Whitney U test; [3]Paired sample t-test; [4]Student t-test; *p<0.05.

**TABLE 5:** The relationship between the changes in VAS, TDQ and Beck scales and anthropometric measurements, food consumption and changes in biochemical parameters at the beginning and end of the study.

| Variables | VAS Scale | | | | TDQ Scale | | | | Beck Scale | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Study group (n=20) | | Control group (n=20) | | Study group (n=20) | | Control group (n=20) | | Study group (n=20) | | Control group (n=20) | |
| | r value | p value | r value | pvalue | r value | p value | r value | p value | r value | p value | r value | p value |
| [1]Difference in anthropometric measurements | | | | | | | | | | | | |
| Body weight (kg) | | | | | | | | | 0.110 | 0.664 | 0.568 | 0.014* |
| Waist circumference (cm) | 0.174 | 0.462 | 0.445 | 0.049* | | | | | | | | |
| [2]Difference in food consumption | | | | | | | | | | | | |
| Total protein (g) | -0.599 | 0.005** | 0.095 | 0.690 | -0.468 | 0.038* | 0.316 | 0.175 | | | | |
| Soluble fiber (g) | 0.478 | 0.033* | 0.221 | 0.349 | 0.638 | 0.002** | 0.514 | 0.020* | | | | |
| Insoluble fiber (g) | | | | | | | | | 0.073 | 0.773 | 0.559 | 0.016* |
| [1]Difference in blood biochemical parameters | | | | | | | | | | | | |
| Serum magnesium (mg/dL) | -0.222 | 0.346 | -0.473 | 0.035* | | | | | | | | |
| Serum folate (ng/mL) | | | | | 0.254 | 0.281 | 0.543 | 0.013* | | | | |

SD: Standard deviation; VAS: Visual analog scale; TDQ: Tinnitus Disability Questionnaire; 1Spearman's rho correlation analysis; 2Pearson correlation analysis; *p<0.05, ** p<0.01.

p=0.048) (Table 4). In the control group, only TDQ score decreased (p=0.016) (Table 4). Additionally, there was no significant change in the Beck scale score at the beginning and end of the study for all patients.

While a significant relationship was found between the change in VAS and TDQ scale of the patients at the beginning and end of study and the change in intake amounts of dietary protein (r=-0.599, p=0.005; r=-0.468, p=0.038) (Table 5) and soluble fiber (r=0.478, p<0.033; r=0.638, p=0.002), no significant relationship was found between the changes in Beck scale and anthropometric measurements, biochemical parameters and food consumption (p>0.05) (Table 5). In the control group, a significant relationship was found between the change in VAS scale at the beginning and end of the study and the change in waist circumference (r=0.445, p<0.049) and serum magnesium (r=-0.473, p=0.035) levels; the change in TDQ scale and serum folate (r=0.543, p=0.013) level; the change in Beck scale and body weight (r=0.568, p=0.014) (Table 5).

## DISCUSSION

This study was planned and conducted to investigate the effect of regular wheat germ consumption (50 g/day) on tinnitus severity, anthropometric measurements and blood biochemical parameters in volunteer patients, all of whom had presented to Gülhane Hospital Department of Otorhinolaryngology with tinnitus.

In a study, 40 patients with tinnitus, vertigo and hearing loss were examined for body weight, glucose metabolism, blood pressure and lipid profiles and compared with healthy control group. BMI values of the patient group were higher than the control group.[23] Obese patients with BMI ≥30 kg/m$^2$ were excluded from the study because obesity itself was a risk for tinnitus. Obesity increases the risk of tinnitus by causing metabolic diseases such as diabetes and hypertension. People with abdominal obesity often develop insulin resistance and have high total cholesterol levels. Waist circumference, which is a good indicator of abdominal obesity, is an important indicator for obesity and metabolic syndrome.[24] In our study, the waist circumference of approximately 50.0% of the patients in both groups was evaluated as high risk; 30.0% of the patients in the study group and 5.0% of the patients in the control group had waist/height ratios above 0.6.

There are studies showing that an increased neck circumference is associated with increased visceral adiposity and serum triglyceride levels.[24-26] In a study conducted with 46 tinnitus patients and 74 control groups, Torriani et al. found that neck circumference greater than 40 cm was a significant risk factor for tinnitus.[24] In our study, more than 80.0% of male patients in both groups had a neck circumference above 37 cm, while 66.7% of female patients in the study group had a neck circumference above 34 cm. Consumption of high-fiber wheat germ can reduce serum triglyceride levels and decrease tinnitus severity by reducing both body weight and fat absorption. But there was no change in anthropometric measurements at the beginning and end of the study for both groups.

There was no correlation between the anthropometric measurements and VAS, TDQ scores in the study group. In the control group, a positive correlation was found between VAS score and waist circumference, Beck score and body weight. It is known that there is a relationship between body weight and depression, which may increase tinnitus intensity.[27]

According to the food consumption diaries, daily energy, CHO and CHO energy percentages of male patients in the control group were significantly higher than the study group and the female patients in the control group had higher energy values from CHO and CHO than the study group. Adding 50 g of wheat germ to the diet of the patients in the study group may have caused the patients in this group to feel full and consume less nutrients for longer than usual.[6]

Whole grain consumption decreases intra-day variability in blood sugar. Postprandial blood glucose levels remain normal, insulin resistance decreases, serum HbA1c levels decrease, diabetes development is reduced and development of chronic complication decreases.[28-30] In addition, healthy food selection can improve internal ear haemostasis.[13] As a result of our study, there was no statistically significant difference in these parameters between the two groups. This may be due to the fact that only wheat germ has been added to the diet and the general diet has not been altered. The overall pattern of the diet may also need to be planned for changes in blood sugar and related parameters.

It was compared with the severity of tinnitus and consumption amount of brown bread in 171,722 patients with tinnitus. Compared to those with continuous tinnitus, it was reported that those with intermittent tinnitus felt that the intensity of tinnitus decreased with whole grain consumption. Whole grains have positive effects on glycemic load, diabetes, blood lipid level and cardiovascular diseases.[31] In our study, TDQ scale of both study and control patients improved at the end of the study compared to baseline. There was a significant decrease in the VAS scale of the study group, which was used to evaluate the level of disturbance of tinnitus in the patients. When the relationship with food consumption is evaluated; there is a negative correlation between soluble fiber intake and TDQ and VAS scores. In our study, fiber intake of male (20.2±6.01 g/day) and female (19.7±6.22 g/day) patients in the study group increased with the addition of wheat germ compared to

the beginning of the study and was higher than the control group. The fiber content and wheat germ consumption could have contributed to this improvement.

Reducing hyperinsulinemia with diet therapy is very beneficial in reducing the symptoms of tinnitus.[32] In a study evaluating the nutritional status, patients were given nutritional education and it was shown that 71.5% of the participants decreased the severity of tinnitus after 7 months of follow-up.[13] In a study by Sutbas et al. involving 42 patients with acoustic trauma and hyperlipidemia, patients were treated with a low-cholesterol diet and hypercholesterolemia treatment.[33] As a result, it was shown that the tinnitus severity of patients was reduced with lower cholesterol levels and hearing thresholds were improved. Another study showed that cholesterol absorption decreased by 42.0% with consumption of a muffin containing 80 g of wheat germ. According to this result, the fiber and phytosterols contained in wheat germ were reported to have a positive effect on cholesterol.[34] In our study, despite the daily intake of additional 8 g of fiber with 50 g of wheat germ on a daily basis for a month, there was no correlation between dietary fiber and serum cholesterol and triglyceride levels and there was an increase in cholesterol and triglyceride levels although it was not significant. This may be caused by the fact that the patients consumed wheat germ often with full-fat yogurt and mostly as a night meal.

The study by Günay et al. showed that anaemia increased the prevalence of tinnitus. In the report published by European Food Safety Authority with respect to wheat germ, the mineral content of wheat germ is reported mainly as K, Mg, Ca, Zn, Fe and Mn.[35,36] However, fiber iron in foods can reduce bioavailability. Whole grains are a good source of fiber, but are also considered as a source of phytate. The presence of 50 mg phytate in a food can reduce Fe absorption by 70%. In addition, the increase in the amount of dietary Ca and P affects Fe absorption adversely.[37] The phytate content of wheat varies according to the type of wheat, the structure of the soil, the climate and the way it is processed. While the amount of phytate in wheat grain was 0.3%, it was determined to be 5% in bran. The amount of phytate in embryo is very low.[38] In this study, levels of serum Fe, ferritin, hemoglobin and hemotocrit levels were decreased in the study group consuming wheat germ containing 15 mg/100 g Fe. However, there was an increase in serum Fe and hemoglobin levels in the control group, but it was not considered significant. Although the phytate content of wheat germ used in the study is not known, we believe that the anaemia tendency seen in the study group is not caused by wheat germ. Because phytates are mostly in wheat bran, only wheat germ was used in this study, not wheat bran. This can be explained by the fact that the daily energy intake of the patients in the study group was low and the phosphorus intake increased with wheat germ.

Inner ear tissue has been shown to store high levels of Zn. However, the effect of Zn supplementation on tinnitus prevention and severity reduction is unclear.[39] In our study, it was seen that patients in both groups did not meet the daily Zn requirement at the beginning and end of the study. However, Zn intake was found to be higher in the female patients in the study group compared to the control group although not significant. Additionally, no significant increase (3.5%) was seen in serum Zn levels of the patients eating wheat germ. However, serum zinc level is higher in the study group compared to the control group. This situation can be interpreted as the contribution of wheat germ.

While there was no significant change in serum vitamin D levels at the beginning and end of the study, the serum vitamin D level of the study group was found higher than the control group at the end of the study. Although there is no relationship between TDQ, VAS and Beck scales, the decrease in the severity of tinnitus in general may have increased the frequency of patients getting into social life and going out.

Medical treatments are not always effective in treating tinnitus. Psychological support is also included in the treatment recommendations.[40,41] However, the fact that patients were monitored for wheat germ consumption may have made them feel better. It has been seen as a remedy for the treatment of tinnitus and may have had a placebo effect.

## CONCLUSION

When the decrease in VAS and TDQ scores in the study group is evaluated, dietary habits and increase in dietary fiber intake may contribute to the decrease in tinnitus severity. Apart from existing methods already known to be effective in the treatment of tinnitus, antioxidant, multivitamin or herbal supplements or functional foods with high nutritional value can be considered and referring patients to nutritionists may contribute to the treatment.

### LIMITATIONS OF STUDY

The limited number of patients included in the study, the short duration of the intervention, and the unchanged meal plan and diet plan can be considered as limitations of the study.

The nutritional value analysis of the wheat germ used in this study has not been conducted. The nutritional value of wheat germ is taken from TUBITAK National Food Composition Database.[42]

### MAIN POINTS

1. A significant relationship was found between the change between dietary soluble fiber intake on the VAS and TDQ scales. Tinnus intensity tended to decrease as soluble fiber intake increased.

2. At the beginning of the study, no significant difference was found between the biochemical values of patients in both groups. At the end of the study; serum zinc and vitamin D values were higher in the study group than the control group, and serum folate value was significantly lower.

3. There was no significant difference between VAS, TDQ and Beck scores between the two groups both at the beginning and end of the study. However; a decrease was observed in VAS and TDQ scores of the patients in the study group at the end of the study compared to the beginning of the study.

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*During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.*

***Conflict of Interest***

*No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.*

***Authorship Contributions***

***Idea/Concept:*** *Gökçen Garipoğlu, Efsun Karabudak;* ***Design:*** *Gökçen Garipoğlu, Efsun Karabudak;* ***Control/Supervision:*** *Gökçen Garipoğlu;* ***Data Collection and/or Processing:*** *Gökçen Garipoğlu, Mert Cemal Gökgöz;* ***Analysis and/or Interpretation:*** *Gökçen Garipoğlu, Mert Cemal Gökgöz;* ***Literature Review:*** *Gökçen Garipoğlu;* ***Writing the Article:*** *Gökçen Garipoğlu, Efsun Karabudak;* ***Critical Review:*** *Efsun Karabudak;* ***References and Fundings:*** *Gökçen Garipoğlu, Mert Cemal Gökgöz;* ***Materials:*** *Gökçen Garipoğlu.*

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