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Effect of Malting on Chemical Composition, Minerals Content and Microbiological Quality in Different Varieties of Barley (*Hordeum vulgare*)

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Abstract

This study was aimed to investigate the effect of malting process on chemical composition and mineral content as well as microbial quality of barley varieties (bakur (A) and balady (B) from Yemen and also local 46(C) from Sudan. All these grains were cleaned, soaked and germinated at temperature30±2ºC for 120 hours. After germination process, grains were dried at 55 ºC for 12 hours. The three barley varieties (A, B and C) showed significant differences ($p< 0.05$) in chemical composition between non-malted and malted. However, the results of non-malted samples(A, ,B, and C) in chemical composition the result were, moisture (6.66, 6.34 and 6.08%), protein (12.62, 11.40 and 11.53%), fat (1.94, 1.75 and 1.49%), Ash (2.72, 2.52 and 2.45%), fiber (3.13, 2.80 and 3.52%), and Carbohydrate (73.15, 75 and 75.22%), while the malted barley samples were shown the following , moisture (4.66, 4.44, 4.35%), protein (11.91, 7.83, 6.47%), fat (1.64, 1.68, 1.60%),Ash(2.48, 2.47, and 2.12%), fiber (4.02, 4.24, 4.47%) and Carbohydrate (75.63, 79.63,80.92%). Moreover, the reducing sugar content of non-malted samples ranged between 0.25% and 0.67%, whereas malted samples between 0.32 and 0.48%. In addition to that, non-reducing sugar ranged between 0.63-0.98% and 1.72-2.74% respectively. The mineral content showed ($p< 0.05$) variations between malted and non-malted samples. Microbial analysis including (total count of bacteria, yeasts, moulds, *E.coil* and *Coliform*) were increased significantly ($p\leq0.05$) in all non-malted and malted samples, while *Salmonella* was not detected.

Keywords: Barley, malting, Chemical composition, Microbiological Evaluation

Introduction

Cereal grains are the most important source of the world's food and have a significant role in human diet throughout the world (FAO, 2008). Barley (*Hordeum vulgare*), like all other true cereals, is a member of the grass family including barley, wheat, maize, rice, rye, millet, oats, sorghum and triticale (Sharma and Gujral, 2010). Whole barley grain consisted of 65–68% starch, 10–17% protein, 4–9% ß-glucan, 2–3% free lipids and 1.5–2.5% minerals. ß-glucans the major fiber constituents in barley, had been shown to lower plasma cholesterol, reduce glycemic index and reduce the risk of colon cancer (Madhujith *et al.*, 2006; Quinde *et al.*, 2004). Barley is an excellent source of soluble and insoluble dietary fiber and other bioactive constituents, such as vitamin E, B-complex vitamins, enzymes, minerals, and phenolic compounds. It has one of the highest levels (up to 9%) of β-glucan, a water-soluble

polysaccharide nutritionally classified as soluble dietary fiber (Fastnaught, 2001). Malted grains are seen in some foods at natural health food stores. The concept behind the use of malted grains is that the enzymes produced during malting convert starch into more digestible maltose and increase the absorption rate of vitamins and minerals during digestion in human. It is known that germination increases free limiting amino acids and available vitamins with modified functional properties of seed components (Gunkel *et al.*, 2002). The objective of this study was to investigate the effect of malting process on chemical composition and mineral content as well as microbial quality of barley varieties (bakur (A) and balady (B) from Yemen and also local 46(C) from Sudan).

Material and Methods

Sources of barley seeds: Varieties of barley used in this study were obtained from Yemen (Bakur (A) andBalady (B); and (local 46 (C)) from Sudan. The grains were cleaned and stored for analysis. All the tests were performed in triplicates.

Malting of Barley: Malting of barley was carried out at the Laboratory of Food Microbiology, College of Agricultural SZtudies, Sudan University of Science and Technology (SUST). Cleaned barley were washed and soaked in distilled water at ratio of(1:3 w/w), using glass beaker at 30ºC for 24 h, then water was renewed every 12 h. The barley seeds were lied on aluminum foil and incubated for four days at 30°C with interval spraying with water every 2h. At the end of germination period the seeds were dried in an oven at 55°C for 12 h, after that the roots of the germinated barley were removed (Badau, 2004).

Chemical Analysis: All analysis were done in triplicate and the results were reported on a dry matter (DM) basis. Moisture, Protein, Fat, crude Fibers and Ash contents were determined according to the methods of (AOAC, 2000).The total carbohydrate was calculated by difference.

Determination of Reducing and Non-Reducing Sugar: Total and reducing sugars were determined according to Lane and Eynon titrimetric method (AOAC, 1990).

Determination of Mineral Content: Analysis of the Iron (Fe), Calcium (Ca), Potassium (K), Zinc (Zn), Manganizum (Mg), Copper (Cu), Sodium (Na) and Phosphorous (P) was carried out according to the standard atomic absorption spectrophotometric (Model 210 VGP) method of (AOAC, 1990).

Microbiological Evaluation

Preparation of serial dilutions: A 10 g of barley seeds with 90 mL of sterile water was homogenized in a stomacher. Then 1 ml of each sample was aseptically transferred to 9 ml of sterile water in a separate tube and mixed vigorously. 1 ml of the resulting mixture was transferred to 9 ml of sterile water in a separate tube. The process was continued until the 8th diluents (10^{-8}).

Total viable count: Total viable count was carried out using Nutrient Agar (MM012, HiMedia) was inoculated with a1 ml of appropriately diluted Barley (10−8) by spread-plating technique and incubated at 37˚C for24 hours. Colonies were counted and multiplied by the dilution factor (APHA 1992).

Yeasts and moulds enumeration: From suitable dilution of sample, 1 ml was transferred onto potato dextrose agar (PDA) (M096, HiMedia). Samples were spread all over the plates using sterile bent glass rod. The plates were incubated at 37°C for 48 hour, plates containing between 30 and 300 colonies were count as colony forming units (cfu/g) (Harrigan and MacCance, 1976).

Coliform bacteria, E. coli: To detect coliform and E. coli, the 3-tube MPN procedure was applied as specified by Feng *et al.* (1998).

Detection of Salmonella: The stage of the pre-enrichment of Salmonella medium was done by mixing 25 g of sample with 225ml of buffer peptone water in a sterile bag. The pre-enrichment culture was incubated for 24 hours at 37°C. The stage of the selective enrichment of Salmonella, one ml of the pre-enrichment culture to 10 ml of selective selenite cysteine broth (M1079, HiMedia) and incubating at 37°C for 24 h. The stage of plating on selective agar media was done by transferring a loopful of the selective enrichment media to the surface of each selective agar media as brilliant green agar (MU016, HiMedia) and spreading to obtain isolated colonies (ISO 6579, 2002).

Statistical analysis: The data analysis was carried out with SPSS Inc. software (version 18.0). One way ANOVA was used to determine whether significant ($P \leq 0.05$) variation occurred among mean of sample parameter between different barley.

Results and Discussion

Chemical composition of barley: Proximate composition of non-malted and malted barley varieties is shown in Table (1).

Moisture content: The moisture content of non-malted barley was 6.66, 6.43 and 6.08% for A, B and C respectively. After malting process, it was significantly decrease ($p>0.05$) in all varieties, the results were 4.66, 4.44 and 4.35% for A, B and C respectively. This finding is the same results that reported by Marconi *et al.,* (2014).

Protein content: The Protein content in non-malted barley was found in range from11.40 to 12.62%. However, after malting it decreased significantly ($P >0.05$) from 11.92 into 6.47% in all samples except sample A. This is agree with the results reported by Makeri *et al.,* (2013), Marconi *et al.,* (2014) , Arif *et al.,* (2011) and Megat *et al.,* (2011). Other studies by Pawar and Machewad (2006) explained that the cause of decreasing protein content was due to leaching process or during transport protein from seeds to roots and then to shoots of plant. On the other hand, many studies conducted by Ghavidel and Prakash (2007) and Kaushik *et al.,* (2010) found that, there was increased of protein content during germination process specifically in legume. Although, Senhofa (2016) observed that, there was a no change in protein content during malting of several cereals such as wheat, oat, barley and rye. But Jones, (2005) concluded that barley proteins degraded into amino acids and small peptides as a result of proteolysis enzymes.

Fat content: Fat content of barley varieties was significantly decreased ($\rho \leq 0.05$) after malting**.** The results showed that non-malted barley were 1.94, 1.75 and 1.60% for A, B and C respectively, while the results of malted barley were significant declined so the results were 1.64, 1.68 and 1. 49 for A, B and C respectively, These results were similar those reported by Arif, *et al.,*(2011) and Warle *et al.,* (2015) revealed that fat content decreased after malting. However, Okafor and Iwouno, (1990) explained that the low fat content is could be due germination process which was benefit in order to prevent foaming capacity in beer manufactured. Also, Youssef *et al.,* (2012) indicated that the changes in lipid fractions might be due to hydrolysis of triglycerides and polar lipid components into simpler compounds during germination process.

Ash content: After malting process, ash content was decreased significantly ($p>0.05$), in all samples except sample B compare with non-malting samples. The ash content of non-malted barley were 2.48, 2.12 and 2.52% for A, B and C, respectively. Although, many studies by Arif, *et al.,* (2011) and Megat, *et al.,* (2011) reported that ash content was decreased due to soaking process. Other study by Pawar and Machewad (2006) showed that the cause of decreasing the ash content of barley in germinated grains was the solubility of minerals in water and leaching out during processing Whereas,

Tatsadjieu *et al*., (2004) showed that, the decreasing of ash content in rice was due to rootlet and washing it by water.

Fiber content: The fiber content of malted samples was increased significantly ($p<0.05$) compared with non-malted samples. However, the results of malted sample were 4.02, 4.24 and 4.47% for (A, B and C) respectively while the results of non-malted samples were 3.13, 2.80 and 3.52 % for A, B and C respectively. The results were supported by the findings of Arif *et al.,* (2011) who studied the effect of malting on the nutrient profile of barley, and observed significant increase from 5.90 to 8.15 percent in the crude fiber content. However, Azizah and Zainon (1997) reported that dietary fiber was decreased in soaked wheat, and barley but conversely increased in soaked rice and soy bean.

Carbohydrates content: The results explained that after malting process the content of carbohydrate in all samples increased, that mean there was significant differences ($p\leq0.05$) between non malted and malted samples. However the results of non-malted were (73.15, 75 and 75.22) for A, B and C respectively. While malted samples were (75.63, 79.25 and 80.92) for A, B and C respectively. Similar results were found by Makeri *et al.,* (2013). This study explained that less moisture and other polysaccharides such as starch are the main factors that impact on increased carbohydrate content in all malted samples.

Table 1: Chemical Composition of different non malted and malted barley

Parameter		Varieties		
		A	B	C
Moisture (%)	Non- malted	$6.66\pm.16^{a}_{a}$	$6.43\pm.15^{b}_{a}$	$6.0878\pm.50^{c}_{a}$
	Malted	$4.66\pm.016^{a}_{b}$	$4.44\pm0.04^{b}_{b}$	$4.35\pm0.021^{c}_{b}$
Protein (%)	Non- malted	$12.62\pm.16^{a}_{a}$	$11.40\pm.20^{b}_{a}$	$11.53\pm0.21^{b}_{a}$
	Malted	$11.91\pm.11^{a}_{a}$	$7.83\pm.090^{b}_{b}$	$6.47\pm.13^{c}_{b}$
Fat (%)	Non- malted	$1.94\pm0.09^{a}_{a}$	$1.75\pm0.073^{a}_{a}$	$1.60\pm0.\ 22^{a}_{b}{}^{b}_{a}$
	Malted	$1.64\pm0.15^{a}_{b}$	$1.68\pm0.025^{a}_{b}$	1.49 ± 0.11
Ash (%)	Non- malted	$2.72\pm.02^{a}_{b}$	$2.52\pm0.025^{b}_{a}$	$2.45\pm0.02^{b}_{b}$
	Malted	$2.48\pm0.015^{a}_{a}$	$2.47\pm0.03^{b}_{a}$	$2.12\pm0.015^{c}_{a}$
Fiber (%)	Non- malted	$3.13\pm0.04^{a}_{a}$	$2.80\pm0.29^{b}_{a}$	$3.52\pm0.02^{c}_{a}$
	Malted	$4.02\pm0.015^{a}_{b}$	$4.24\pm0.02^{b}_{b}$	$4.47\pm0.03^{c}_{b}$
Carbohydrate (%)	Non- malted	$73.15\pm0.13^{a}_{a}$	$75\pm0.390^{b}_{a}$	$75.22\pm0.726^{b}_{a}$
	Malted	$75.63\pm0.12^{a}_{b}$	$79.25\pm0.25^{b}_{b}$	$80.92\pm0.27^{c}_{b}$
Energy (Kcal/100g)	Non -malted	$350.86\pm0.67^{a}_{a}$	$352.6\pm0.99^{a}_{a}$	$353.02\pm2.09^{a}_{a}$
	malted	$364.97\pm0.86^{a}_{b}$	$363.83\pm0.15^{a}_{b}$	$362.90\pm1.07^{b}_{b}$

A= Bukur, B= Balady, C =Local 46.
Values are mean ± SD for triplicates independent runs.
*Means carrying the same superscription letter in each row no signifacint different ($p \leq 0.05$).
⁎Means carrying the same subscription letter in each column no signifacint different ($p \leq 0.05$).

Reducing, Non-reducing and Total Sugars contents of non-malted and malted barley: Table (2) shows total, reducing and non-reducing sugar contents of non-malted and malted barley. Reducing sugar for non-malted barley content was (0.67, 0.25 and 0.37 mg/100g for A, B and C respectively. and non-reducing was (0.41, 0.48 and 0.32 mg/100g) for A, B and C respectively. while reducing sugar and non- reducing sugar in malted barley content was (0.41, 0.48 and 0.32 mg/100g) and (2.17, 2.74 and 1.72) for A, B and c respectively. Malting process caused significant ($P \leq 0.05$) increases in sugars (Table 2).These changes in sugar content maybe due to mobilization and hydrolysis of polysaccharides during soaking and germination processes, Hooda and Jood, (2003).

Table 2: Reducing, non-reducing and total sugars in Non malted and malted barley

Parameter	Treatment	Varieties		
		A	B	C
Reducing Sugar	Non- malted	$0.67\pm0.008^{a}_{a}$	$0.254\pm0.009^{b}_{a}$	$0.379\pm0.00^{c}_{a}$
	Malted	$0.416\pm0.013^{a}_{b}$	$0.481\pm0.00^{b}_{b}$	$0.32\pm0.050^{c}_{b}$
Non -Reducing sugar	Non- malted	$0.63\pm0.137^{a}_{a}$	$0.846\pm0.057^{b}_{a}$	$0.98\pm0.00^{c}_{a}$
	Malted	$2.17\pm0.173^{a}_{b}$	$2.74\pm0.05^{b}_{b}$	$1.72\pm0.13^{c}_{b}$
Total sugar	Non- malted	$1.30\pm0.057^{a}_{a}$	$1.10\pm0.00^{b}_{a}$	$1.35\pm0.02^{c}_{a}$
	Malted	$2.59\pm0.00^{a}_{b}$	$3.23\pm0.057^{b}_{b}$	$2.04\pm0.00^{c}_{b}$

A= Bukur, B= Balady, C =Local 46.
Values are mean ± SD for triplicates independent runs.
*Means carrying the same superscription letter in each row no signifacint different ($p \leq 0.05$).
*Means carrying the same subscription letter in each column no signifacint different ($p \leq 0.05$).

Minerals content: Table (3) showed that minerals content such as (Ca, K, Na, Cu, Fe, Mg, Mn and Zn) (mg/100g) in both non-malted and malted barley. Potassium, recorded the highest value among other minerals. On the other hand, Copper was recorded lowest. However the results showed non malted sample more than malted sample in all minerals. These results agree reported by Ereifej and Haddad (2000) in Jordon and Morocco. It can be observed that minerals content decreased by germination which may be due to steeping water Urbano *et al.*,(2005).

Table 3: Mineral content (mg/100g) of non-malted and malted barley

Minerals	Treatment	Varieties		
		A	B	C
Ca	Non-malted	$27.17\pm1.37^{a}_{a}$	$212.11\pm4.88^{b}_{a}$	$24.35\pm1.38^{a}_{a}$
	Malted	$26.66\pm 0.54^{a}_{a}$	$207.95\pm5.88^{b}_{a}$	$22.52\pm0.20^{a}_{b}$
K	Non-malted	$298.67\pm0.81^{a}_{a}$	$266.68\pm1.17^{b}_{a}$	$252.67\pm4.02^{c}_{a}$
	Malted	$277.27\pm5.54^{a}_{b}$	$249.82\pm9.86^{b}_{b}$	$220.11\pm0.60^{c}_{b}$
P	Non-malted	$228\pm5.75^{a}_{a}$	$231.6\pm1.10^{a}_{a}$	$209.81\pm0.95^{b}_{a}$
	Malted	$210.99\pm1.21^{a}_{b}$	$228.15\pm5.07^{b}_{a}$	$213.66\pm2.31^{a}_{a}$
Na	Non-malted	$9.60\pm0.63^{a}_{a}$	$6.56\pm0.26^{b}_{a}$	$8.19\pm0.63^{c}_{a}$
	Malted	$6.56\pm0.25^{a}_{b}$	$5.38\pm0.095^{b}_{b}$	$6.56\pm0.26^{a}_{b}$
Cu	Non-malted	$0.95\pm 0.29^{a}_{a}$	$0.54\pm0.03^{b}_{a}$	$0.68\pm0.02^{c}_{a}$
	Malted	$0.73\pm0.05^{a}_{b}$	$0.49\pm0.011^{b}_{a}$	$0.51\pm0.1^{b}_{b}$
Fe	Non-malted	$2.54\pm 0.020^{a}_{a}$	$1.93\pm0.68^{b}_{a}$	$2.12\pm0.01^{b}_{a}$
	Malted	$1.96\pm0.15^{a}_{b}$	$1.55\pm0.12^{a}_{b}$	$2.04\pm0.03^{a}_{b}$
Mg	Non-malted	$64.27\pm2.31^{a}_{a}$	$52.64\pm0.39^{b}_{a}$	$68.53\pm0.92^{c}_{a}$
	Malted	$60.53\pm0.68^{a}_{a}$	$51.37\pm0.95^{b}_{a}$	$60.87\pm0.77^{a}_{b}$
Mn	Non-malted	$1.29\pm 0.02^{a}_{a}$	$1.15\pm 0.05^{b}_{a}$	$1.23\pm0.06^{a}_{a}$
	Malted	$1.08\pm0.01^{a}_{b}$	$1.02\pm0.051^{b}_{b}$	$1.02\pm0.01^{b}_{b}$
Zn	Non-malted	$1.65\pm 0.13^{a}_{a}$	$1.49\pm0.12^{a}_{a}$	$1.77\pm0.26^{a}_{a}$
	Malted	$1.48\pm0.30^{a}_{a}$	$1.55\pm0.18^{a}_{a}$	$1.31\pm0.1^{a}_{b}$

A= Bukur, B= Balady, C =Local 46.
Values are mean ± SD for triplicates independent runs.
*Means carrying the same superscription letter in each row no significant different ($p \leq 0.05$).
*Means carrying the same subscription letter in each column no significant different ($p \leq 0.05$).

Microbiological Evaluation: The results of the microbiological analysis of non-malted and malted barley samples are shown in Table 4.In this study, the total count of non-malted barley was (4.02, 4.22 and 4.70 cfu/g for A, B and C) varieties respectively. Total count of bacteria in non-malted barley showed no significant different ($p<0.05$) between A and B, but there are significant different between them and sample C. During

malting process, the total count of bacteria increased significantly ($p \leq 0.05$).Yeasts and Moulds count in the non-malted barley (3.95, 4.01 and 3.55 cfu/g). There was a significant increase ($P<0.05$) in yeasts and moulds of malted barley. Victor *et al.,* (2013) and Batool *et al.,* (2012) found similar results of total count bacteria and yeast of maize and wheat flour. Salmonella spp. were not detected in both non-malted and malted barley samples. However, similar result was reported no *salmonella* in wheat flour by Aydin *et al.,* (2009).

Table 4: Microbiological analysis of non-malted and malted barley

Microbial tests	Treatment	Varieties		
		A	B	C
Total count (cfu/g)	Non- malted	$4.025\pm 0.02^{a}{}_{a}$	$4.225\pm 0.16^{a}{}_{a}$	$4.7\pm 0.03^{b}{}_{a}$
	Malted	$6.064\pm 0.04^{a}{}_{b}$	$6.555\pm0.29^{b}{}_{b}$	$6.15\pm 0.08^{a}{}_{b}$
Yeast and moulds	Non- malted	$3.95\pm 0.11^{a}{}_{a}$	$4.015\pm0.49^{a}{}_{a}$	$3.555\pm 0.13^{a}{}_{a}$
(cfu/g)	Malted	$4.07\pm 0.008^{a}{}_{b}$	$4.19\pm0.009^{b}{}_{b}$	$4.10\pm 0.08^{a}{}_{b}$
Coliform	Non- malted	$3.35\pm0.77^{a}{}_{a}$	$110\pm0^{b}{}_{a}$	$6.1\pm3.2^{c}{}_{a}$
(MPN/g)	Malted	$<110\pm0.00^{a}{}_{b}$	$<110\pm0.00^{a}{}_{b}$	$<110\pm0.00^{a}{}_{b}$
E.coli(MPN/g)	Non- malted	$5.6\pm3.5^{a}{}_{a}$	$4.1\pm0.40^{a}{}_{a}$	$2.6\pm0.24^{a}{}_{a}$
	Malted	$2.05\pm0.05^{a}{}_{a}$	$4.4\pm 0.73^{b}{}_{a}$	$110\pm00^{c}{}_{b}$
Salmonella	Non- malted	N.D	N.D	N.D
	Malted	N.D	N.D	N.D

A= Bukur, B= Balady, C =Local 46.
Values are mean ± SD for triplicates independent runs.
*Means carrying the same superscription letter in each row no significant different ($p \leq 0.05$).
*Means carrying the same subscription letter in each column no significant different ($p \leq 0.05$).
N.D = Not Detected.

Conclusion

This study reveals the following in germination of barley varieties, moisture, Protein and fat were decreased while ash and carbohydrates were increased in all germinated samples. However, total dietary fiber was increased in malted barley compared with non-malted barley. Also, it revealed that, Barley is a good source of necessary nutrients and mineral content. Furthermore, germination process of barley plays important role for improving nutritional value and also it is easy to be digested. To this, it is highly recommended as essential food components. In addition malting, leads to increase the total number count of bacteria.

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تأثير عملية الإنبات على التركيب الكيميائي والمحتوي المعدني و الجودة الميكروبية في أصناف مختلفة من الشعير (*vulgare Hordeum*)

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المستخلص

هدفت هذة الدراسة لمعرفة تأثير الأنبات على التركيب الكيميائي، ومحتوى المعادن وكذلك الجودة الميكروبية لأصناف الشعير Balady (B) -bukur (A) من اليمن، LOCAL 46(C) من السودان. جميع الحبوب تم تنظيفها ونقعها وإنباتها على درجة حرارة 30±2°م لمدة 120 ساعة. بعدعملية الإنبات جففت الحبوب عند درجة حرارة 55° م لمدة 12 ساعة. وجدت أن هناك فروق معنوية ($p\leq0.05$) بين الشعير غير المنبت والمنبت في التركيب الكيميائي للأصناف الثلاثة (A)، (B) و(C) . كان التركيب الكيميائي للعينات غير المنبتة على النحو التالي: الرطوبة (6.66، 6.34 و 6.08%)، البروتين (12.62، 11.40و11.53%)، الدهن (1.94، 1.75 و 1.49%)، الرماد (2.72، 2.52 و 2.45%)، الألياف (3.13، 2.80 و 3.52%)، والكربوهيدرات (73.15، 75و75.22%). بينما في عينات الشعير المنبت كانت الرطوبة (4.66، 4.44 و 4.35%)، البروتين (11.91، 7.83 و6.47%)، الدهن (1.64، 1.68 و1.60%)، الرماد(2.48، 2.47 و2.12%)، الألياف (4.02، 4.24 و4.47%) والكربوهيدرات (75.63، 79.63 و80.92%). فيما يتعلق بالسكريات المختزلة تراوحت بين(0.25 و 0.67%) في عينات الشعير الغير منبت، بينما في عينات الشعير المنبت تراوحت بين (0.32 – 0.48%)، أضافة إلي ذلك تراوحت السكريات الغير مختزلة في عينات الشعير الغير منبت والمنبت (0.63 – 0.98%) و (1.72–2.74 %) على التوالي. فيما يخص المحتوي من المعادن ظهرت فروق معنوية ($p\leq0.05$) بين الشعير الغير منبت والمنبت في كل العينات. التحليل الميكروبي لعينات الشعير الغير منبت والمنبت اظهرت زيادة معنوية ($p\leq0.05$) في العدد الكلي للبكتيريا ،الخمائر ،,والاعفان، الايشيريشيا كولاي والكوليفورم. بينما لم يتم الكشف عن بكتيريا السالمونيلا.