biology and life sciences forum

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Proceeding Paper

Nutritional Characterization of Ancestral Organic Wheats: Emmer, Khorasan and Spelt †

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† Presented at the IV Conference Ia ValSe-Food CYTED and VII Symposium Chia-Link, La Plata and Jujuy, Argentina, 14–18 November 2022.

Abstract: Nowadays, consumers show a growing interest in the consumption of foods made with ancestral grains, the main components of the diet of our ancestors. The ancestral grains come from millenary cultivars and have now burst onto the international market as part of a nutritious and healthy diet. Some of these crops refer to ancestral wheats. The objective of this study was to determine the nutritional characteristics of ancient wheats compared to the modern one. Ancient crops such as emmer (*Triticum dicoccum*, known as "farro medio" or "farro"), khorasan (*Triticum turanicum*, the best known kamut) and/or spelt (*Triticum aestivum* ssp. spelta, known as "escanda" or "farro grande") were the raw materials of the current investigation. Characterization of wheat seeds/whole flours in terms of moisture, ash, total dietary fiber, proteins, and lipids, phytates and phytase activity were determined. In general, these analyses do not support the suggestion that ancient wheats are generally more nutritious and/or healthy than modern wheats. The results support the consumption recommendation of the intake of whole grains (modern or ancients) to prevent non-transmissible illnesses.

Keywords: ancestral grains; emmer; khorasan; spelt; nutritional characteristics

Citation: Athinaiou, A.; Aja, S.; Haros, C.M. Nutritional Characterization of Ancestral Organic Wheats: Emmer, Khorasan and Spelt. *Biol. Life Sci. Forum* **2022**, *17*, 6. https://doi.org/10.3390/blsf2022017006

Academic Editor: Norma Sammán, Mabel Cristina Tomás and Loreto Muñoz

Published: 23 October 2022

1. Introduction

Wheat is one of the oldest crops. The origin and evolution of wheat has been the subject of study over the years [1]. The development of new special foods based on grain blends has permitted the use of the so called "ancient wheats" as components that convey naturalness, unconventional and nutritional properties [2]. The attention towards these ancient species have also been renewed by the increasing demand for traditional products [2]. However, about 95% of the wheat produced is Triticum aestivum, a hexaploid species usually called "common", "bread" or "soft" wheat [3] and the ancestors represent the remainder of the percentage.

The ancient wheats khorasan (*Triticum turgidum* ssp., the best known kamut, tetraploid), emmer (*Triticum dicoccum*, knowing as "farro medio" or "farro", tetraploid) and spelt (*Triticum aestivum* ssp. spelta, knowing as "escanda" or "farro grande", hexaploid) have been cultivated in very low amounts compared to the common wheat species (*T. aestivum* L., hexaploid) [4].

On the other hand, a meta-analysis confirmed the association between the consumption of whole grains and a substantial and significant decreased risk for cardiovascular disease, cancer which reveals the importance of consuming whole grains [5].

The purpose of this study was to determine the nutritional characteristics of ancient wheats compared to the modern ones.

2. Materials and Methods

2.1. Materials

Ancient crops such as khorasan, spelt organic and commercial common wheat were found at local Spanish market, whereas emmer was found at a Greek local market. Figure 1 shows the ancient wheats used in this study.

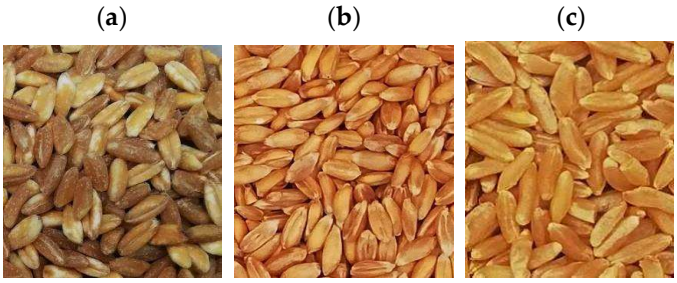

Figure 1. Organic ancestral wheats. (**a**) Emmer; (**b**) Spelt; (**c**) Khorasan.

2.2. Composition of the Raw Materials

Proximate analyses of the raw materials were performed in terms of moisture (AOAC 925.09 Method) [6], protein (ISO/TS 16634-2) [7], lipid (AACC Method 30-10) [8], ash contents (AACC Method 08-03) [8] and total dietary fibre (TDF) (AOAC Method 991.43) [6]. Measurements were taken three times.

Determination of *Myo-Inositol* Hexakiphosphate. The concentration of *myo*-inositol hexakisphosphate or phytic acid (InsP_6) was determined as phosphorus released by phytase and alkaline phosphatase by a quantity K-PHYT method [9]. The phosphate released was measured by a colorimetric technique (AOAC Method 986.11) [6]. All measurements were taken three times.

Phytase activity. The phytase activity was determined according to the methodology described by Haros et al. [10] expressed in U/g of wheat, whereas one unit (U) was defined as 1.0 µmol of Pi liberated per hour at 50 °C and pH: 5.5.

Statistical Analysis. To establish significant differences between samples one-way ANOVA and Fisher's least significant differences (LSD) were applied, all differences were considered significant at $p < 0.05$.

3. Results

The moisture values obtained for the wheats analyzed were very similar, the high moisture value is for spelt, control and organic wheat, emmer, followed by khorasan, respectively. It should be noted that khorasan wheat has the highest protein value of the ancestral varieties studied (approximately more than 30% respect to the control) followed by spelt wheat (Figure 2). The other wheats, such as emmer, control and organic, presented significantly lower values than the previous ones. It is important to remark that all wheats have the proteins which form the gluten. However, ancient wheats, despite having higher protein contents, they do not present higher gluten (data does not show).

Regarding the lipid values, we observe that the highest value obtained corresponds to spelt, followed by khorasan wheat, emmer, organic and control with values very similar between them. It is observed that the total dietary fiber values were very similar, with higher values for organic wheat, followed by khorasan, spelt and control wheat, and the lowest value for emmer wheat (Figure 2).

The highest values for ash were obtained for spelt and emmer wheats, followed by organic and khorasan and very closely continued by the control wheat. In terms of phytic acid concentration the highest value corresponds to spelt, followed by organic and khorasan wheat, because the values were very similar, and the next lowest was the control and emmer wheat (Figure 3). The phytic acid forms the phytate salts with minerals, which are the mineral storage in plants. On the other hand, phytase is the enzyme which hydrolyses the

phytic acid/phytate in lower *myo*-isnositol phosphate, realizing inorganic phosphate. The phytase activity in all the investigated whole wheat flours presented significantly similar values between samples and according to previous works (Figure 4).

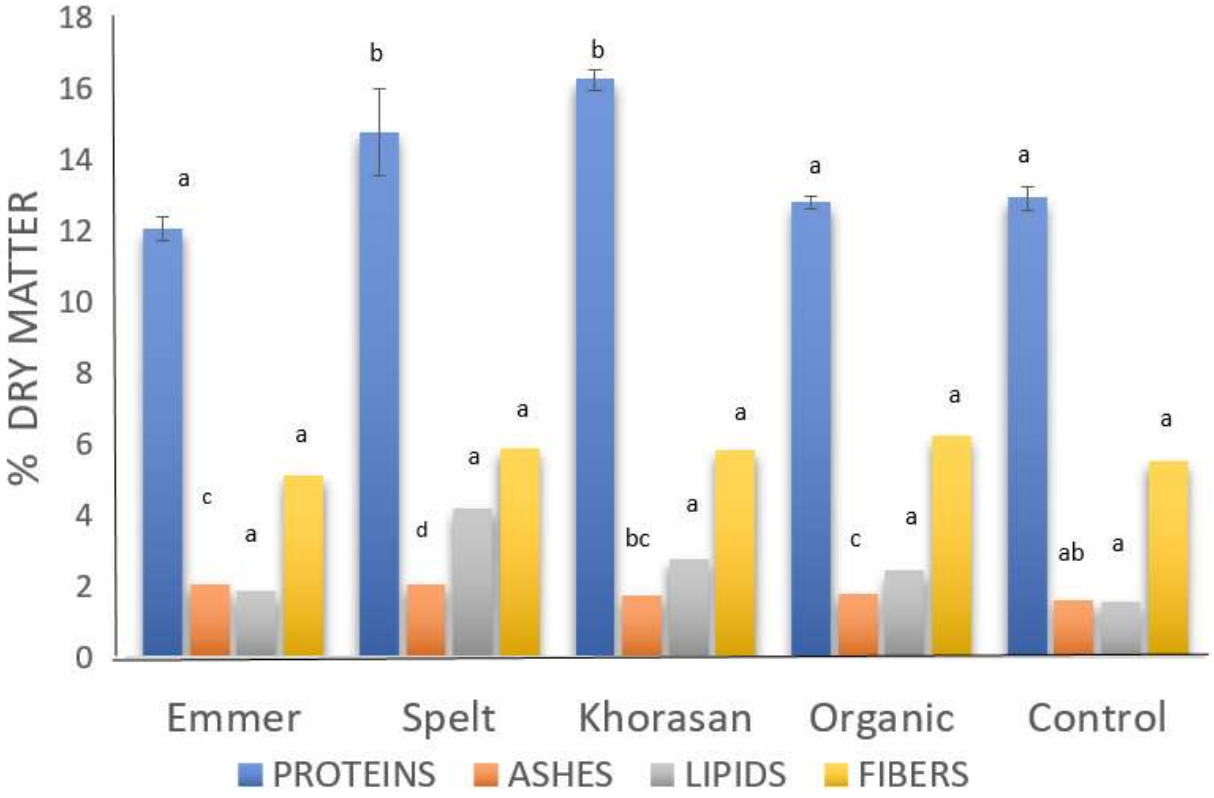

Figure 2. Proximate composition of the organic ancestral wheats comparing to modern wheats (organic and control). Data are expressed as mean ± standard deviation (n = 3), Values in bars followed by the same letter, in the same parameter, are not significantly different at 95% confidence level ($p < 0.05$).

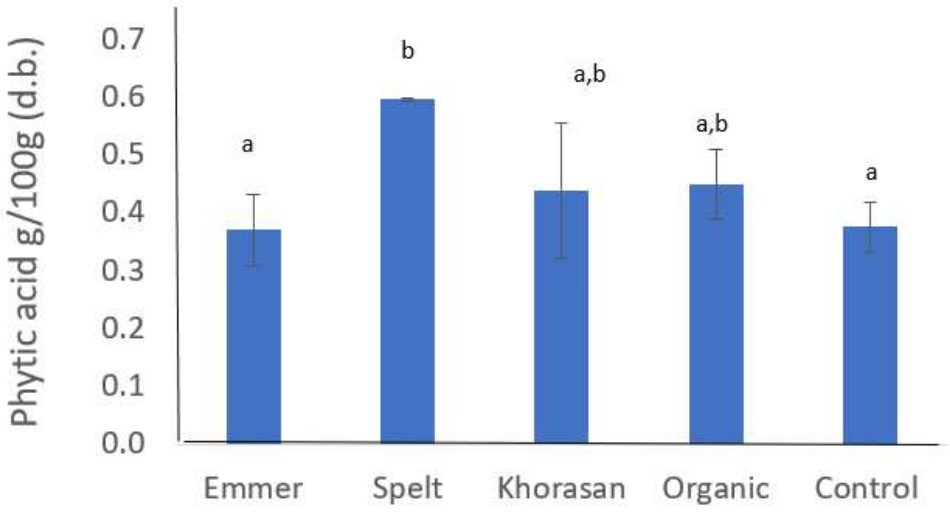

Figure 3. Phytic Acid content in ancestral wheats. Data are expressed as mean ± standard deviation (n = 3), Values in bars followed by the same letter are not significantly different at 95% confidence level ($p < 0.05$). Dry basis, d.b.

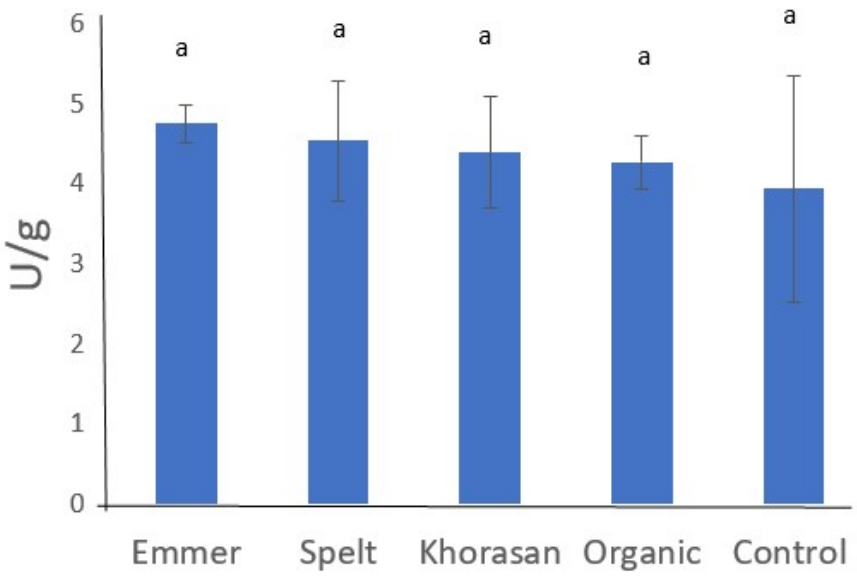

Figure 4. Phytase Activity. Data are expressed as mean ± standard deviation (n = 3), Values in bars followed by the same letter are not significantly different at 95% confidence level ($p < 0.05$).

4. Conclusions

Protein content was referred to as the most important factor that affects bread-making and baking quality. In our study khorasan wheat represents the highest value, but this value does not mean that they correspond to a significant amount of gliadins and gutenins, which are the proteins that constitute gluten. According to the ash values, the results for the seed spelt and emmer confirms their high nutritional value of the seeds compared to the other varieties. However, phytic acid has been considered as an anti-nutrient factor in human nutrition due to its effect on the inhibition of mineral bioavailability. According to our results, the spelt sample presented the highest percentage of mineral but also the highest phytate content, which could affect their bioavailability. The phytase activity was similar in all the studied wheats, but there was a tendency for higher values in ancestral wheats compared to the control wheats, which could produce the phytic acid degradation more efficiently during the fermentation step in the development of cereal products. Although the results cannot confirm that ancestral wheats are more nutritious than common wheat. The whole grain intake is still being the best strategy to obtain the high amount of nutrients and bioactive of cereal grains.

Author Contributions: Conceptualization, C.M.H.; methodology, A.A. and S.A.; validation, S.A. and C.M.H.; formal analysis, A.A. and S.A.; investigation, A.A. and C.M.H.; resources, C.M.H.; writing—original draft preparation A.A. and S.A.; writing—review and editing, C.M.H.; visualization, A.A. and S.A.; supervision, C.M.H.; project administration, C.M.H.; funding acquisition, C.M.H. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by grant Ia ValSe-Food-CYTED (119RT0567) and Food4ImNut (PID2019-107650RB-C21) from the Ministry of Sciences and Innovation (MICINN-Spain).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The fellowship of Aikaterini Athineou from the ERASMUS+ Program EU is gratefully acknowledged.

Conflicts of Interest: The authors declare no conflict of interest.

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