

# Ancient and modern grains, effects on human health: A first short review

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**Abstract:** A short review concerning the distinction between ancient and modern grains or ancient and modern varieties of wheat, cereals and pseudocereals, along with their quality related mainly to human health and that of the environment is provided. Modern plant breeding, especially that started before the Green Revolution, based mainly on gross selection and very few crosses among local varieties/populations may be considered ancient grains, while those obtained after the Green revolution, based on intensive and multiple crosses among local and foreign varieties, including those obtained by induced mutation, may be considered modern grains. According to recent researches, it seems that ancient grains are healthier than the modern ones. The former would also have a lower environmental and agricultural impact than the latter. Since the picture on this topic is not yet clear I was asked to throw on it more light. In fact, most of researchers in the field do not understand difference among ancient and modern varieties. Thus, the objective of this short paper was to clarify and stimulate more research, possibly with a multidisciplinary approach. In Italy, for instance, there are *ad hoc* research projects that should be more adequately financed and supported, during their development. To make it easy, I have mentioned and listed more than thirty references.

**Keywords:** Ancient and modern grains, Breeding, Environmental and agricultural impact, Wheat

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## 1. Introduction

It seems that ancient grains do not have a scientific definition [1]. Broadly speaking, ancient grains is a marketing term used to describe a category of grains and pseudocereals that are purported to have been minimally changed by selective breeding over recent millennia, as opposed to more widespread cereals such as corn, rice and modern varieties of wheat, which are the product of thousands of years of selective breeding or domestication under cultivation [2].

Ancient grains include varieties of wheat (hulled wheat: spelt, einkorn, and emmer), millet, barley, teff, oats, sorghum and pseudo-cereal (quinoa, amaranth, buckwheat, and chia) [3]. Some authors even consider bulgur (cracked parboiled groats of several different wheat species, most often from durum wheat) and freekeh (a cereal food made from green durum wheat that is roasted and rubbed to create its flavour) to be ancient grains [4-6], even though they are usually made from ordinary wheat. Modern wheat is a hybrid descendant of three wheat species considered to be ancient grains: spelt, einkorn and emmer [7].

Ancient wheat may refer to wheat selected from wild species of *Aegilops* L. [8,9], not used for the productivity and protein composition and therefore with a possible low gluten content. On the other hand, plant breeders would consider wild *Aegilops* a wild wheat progenitor or a crop wild relative, rather than an ancient wheat [10,11].

Due to lack of scientific definitions to identify ancient from modern grains, most of the breeders have agreed to call ancient varieties of hard and soft wheat those selected

before the Green Revolution, i.e. before the 1960s. In particular, in Italy, since the 1920s, with Nazareno Strampelli and much later with Francesco D'Amato [12], the genetic improvement of wheat objectives were to increase the yield in grains per hectare and improving their protein content [13]. Unfortunately, the improvement has led to the increase of two proteins, gliadins and glutenins, which provide flour with a better aptitude for pasta making, in durum wheat, or bread-making, in soft wheat. Therefore, an improvement aimed at satisfying industrial and non-nutritional and functional needs.

The consequence was that for over half a century many modern varieties were obtained with grains richer in some protein fractions, good for the processing industry, but not always good for health [14]. In fact, the lower digestibility of baked products obtained with modern wheat compared to those obtained with ancient wheat is mostly attributed to the quality of gluten. To a lesser digestibility are connected different intolerances and bad assimilation of nutrients present in the food obtained with modern varieties [15-17]. Often, people talk of celiac disease and intestinal gluten sensitivity [18,19], but the diseases that can develop are numerous, complex and variable according to the different genetic of people using that food.

These pathologies have gradually emerged in the world population, but only a few decades ago they have called the attention of the experts, who wanted to control the existence of possible relationships between grain chemical composition and pathologies. The literature on the subject is controversial, but the milestone includes two simple concepts: adequate diet and physical activity, also defined as lifestyle. In the era of evidence-based medicine, it is possible to underline the role of a healthy alimentary regimen in a medical approach focused on preventing a spectrum of chronic diseases, including metabolic disorders [20].

Ancient grains often marketed as being more nutritious than modern grains, though their health benefits have been disputed by some nutritionists [7,21] and chemistry [22]. The present paper concerns mainly with ancient grains and/or ancient varieties rather than ancient pseudocereals.

## 2. Methodology

Since the aim of this short review was to make a preliminary survey to understand if it is the case to investigate the possibility to take care of human health and that of the environment, to which the former is linked anyway, by comparing plant food provided by ancient and modern varieties of cultivated plants. To reach this purpose the author has gone through the most relevant and more accessible literature. Now was tried to build a file, much of which not used for this paper, due to difficulties in understanding the objectivity of data and results. Doubtful papers are therefore in standby. In many cases the results are clearly very much biased and in favor of modern or ancient varieties without a real scientific support. Thus, the previous introduction and the following discussion is based on a selected literature, and in any case still under examination. A definitive answer may come later, hoping to have a follow up of the actual investigation and possibly with researchers and institutions without conflicts of interest.

## 3. Results and Discussion

Several researches show differences between ancient and modern wheat, arguing that the former are better at least from the functional point of view [13,14,23-25] and there are researches that claim that genetic improvement has improved grains from a technological point of view, but also from a functional one [26-27].

However, a research group analyzing the functional components of the grains of some hard wheat, ancient and modern, showed that the values of 70 phenolic compounds, including coumarins, phenolic acids, anthocyanins, flavones, isoflavones, proanthocyanidins, stilbenes, and lignans present in ancient grains are twice or more than those of

modern wheat. Thus, ancient wheat provides unique nutraceutical values that are absent in modern wheat [28].

A study aimed at assessing the influence of the consumption of pasta obtained with ancient durum wheat, on some parameters related to the atherosclerotic process, showed a significant improvement in cholesterol, blood viscosity and erythrocyte deformability. Several researchers say that the beneficial effects of ancient durum wheat pasta are most likely attributable to a combination of effects rather than the effect of a single component [23,29]. Some researchers wanted to analyze the profiles and the distribution of lignans present in the whole grain of soft wheat, as they are compounds that have beneficial effects on human health. Lignans such as arctigenina, hinokinina and syringaresinol were present only in ancient varieties [29]. The same research group investigated the health properties of various ancient and modern soft wheat and confirmed that generally the grains of ancient varieties contain many more phenols, flavonoids, coumarin, stilbene, proanthocyanidin and lignans than the modern ones [31].

A study on the effect of the cultivation environment, the genotype of wheat and their interactions (genotype x environment) on the phytochemical composition of the grain of different soft wheat, has shown that, in general, the environment has a greater influence on the beneficial effects of the antioxidant properties of the components of the bran with respect to the genotype and genotype-environment interaction. The environment has had a greater impact on the content of  $\alpha$ -tocopherol,  $\delta$ -tocopherol, total tocopherols, total phenols, ferulic acid and antioxidant capacity [32].

A more recent study, on ancient soft wheat, wanted to ascertain the optimal balance between the presence of secondary metabolites having beneficial effects both on health and on technological characteristics. The results confirmed a significant effect of the environment on the various parameters considered. Some ancient wheat showed the best values of the antioxidant properties of polyphenols, but also for the protein and gluten content. Therefore, there are ancient wheat good both for health and for industry [24]. Researchers have studied the effects of eating bread made from ancient soft wheat on several volunteers. The data obtained suggest that this bread was effective in reducing cardiovascular risk factors, along with a significant reduction in cholesterol and blood glucose levels [25].

A research group for diabetics has found that wheat gluten causes inflammation in genetically predisposed individuals [18]. A study on intestinal dendritic cells examined how their dysfunction contributes to the development of intestinal disease, including the inflammatory and celiac disease [19], although, unfortunately, the mechanisms that regulate the absorption of ingested proteins are not yet clear [18,33].

Finally, a group of experts in food sciences carried out an investigation into how modern wheat and their transformation can influence the so-called wheat sensitivity. The study after examining the main diseases related to the use of wheat (celiac disease, wheat allergy, non-celiac sensitivity to wheat, bad fructose absorption and irritable bowel syndrome) concludes that: the monococcum, a very ancient diploid wheat, is among the most promising because it produces less toxic effects; for people with wheat sensitivities, less reactive grain-based products can slow the development of the disease and improve the quality of life; while the research failed in searching the cause of the increased sensitivity to wheat, the modern transformation of wheat may have contributed to increasing exposure to immunoreactive compounds; further research is therefore needed to understand the influence of modern varieties on epidemiological change [34]. Nevertheless, in the above mentioned review, a cited work [35] highlights a notable difference between modern and ancient varieties: 91% of modern wheat present immune reactions against 9% of the ancient wheat. Based on numerous studies, it may be due to the greater presence of particular gliadins and glutenins present in modern wheat. The authors conclude that due to the great variability existing between species and wheat genotypes, the best thing is to

choose wheat with the lowest contents of reactive proteins and the highest contents of antioxidant molecules.

#### 4. Conclusions

The results of the mentioned studies suggest that the problem of digestibility is complex, as it may depend on several factors: genetic predisposition of people, presence of reactive proteins in the grain, human physical activity, but also the absence or deficiency of polyphenols or other antioxidant molecules. In general, scientific studies confirm that ancient wheat varieties may provide a food healthier than modern varieties. However, not always differences between ancient and modern grains are clear, but this may be due to differences within ancient as well as within modern varieties due also to their genetic background and genetic evolution. In addition, the environment and the method of cultivation, as well as the transformation and food processing, from milling to cooking, may play an important role. In the end, from an optimistic point of view and since human health is very important, one could conclude that there are good reasons to investigate further ancient and modern varieties, taking into account also the lower environmental and agricultural impact of the former.

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