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ARTICLE

Ancient Versus Modern Wheat: Present Day Consumers Dilemma to Good Health

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Wheat is a cereal grain, that has a great impact on human nutrition and health. It is a major source of proteins, carbohydrates, and dietary fibers. At present there is considerable interest in the ancient wheats that were present in the Fertile-crescent and then naturally hybridized to give rise to the modern day allohexaploid wheat[1]. The modern wheat varieties have been further improved by plant breeding techniques to develop varieties with improved agronomic traits such as yield and desirable bread making qualities[2]. However, easy availability of food and over-consumption has led to a high calorie intake. This combined with a less active lifestyle has resulted in obesity and associated non-communicable diseases such as type 2 diabetes and cardiovascular diseases [3]. These diseases have seen an increase over time[3]. Globally, there is a sentiment believed by some that modern wheat has changed over time and may have played a role in the increase in the lifestyle associated ailments [4]. The objective of this study was to compare the wheat grain composition in ancient wheats to representative modern wheat varieties to characterize the changes if any. A wheat grain is composed of different nutritional components such as carbohydrates, proteins and lipids. This study looked at the starch, dietary fiber, arabinoxylans and the digestibility of the wheat grain.

OBJECTIVE

To analyze the grain nutritional composition of ancient and modern wheat varieties.

HYPOTHESIS

The hypothesis of the present study is that ancient and modern wheats differ in their grain nutritional composition[4].

METHODS

Wheat varieties were the materials used in this project. The materials were harvested from the 2016 crop year in the Plant Sciences, University of Saskatchewan research farm in Saskatoon. Table 1 shows the wheat varieties used.

This study was done at the University of Saskatchewan in the Plant Sciences department. Professor Chibbar and his team helped in the analysis of the different grain components.

Total Starch: Total starch concentration was determined using enzymatic procedures[5]. Enzymes were used to convert starch to glucose which was measured using a spectrophotometer at 510 nm.

Total Dietary Fiber: The total dietary fiber (TDF) was determined by the enzymatic hydrolysis of wheat meal[6]. Enzymes were used to solubilize and depolymerize starch and protein. The residue was treated with ethanol and filtered. The dried residue was used to calculate the TDF.

Total Protein: A combustion method was used to determine protein concentration using LECO Protein analyser[7]. The protein analyser is a microprocessor based, software-controlled instrument that determines the nitrogen content in wheat. In the analyser the sample is purged, burned and nitrogen is separated. The nitrogen levels were used to determine the levels of protein.

Total Arabinoxylans: Arabinoxylans are a major component of dietary fiber in cereal grains. The Phloroglucinol colorimetric method[8] with slight modifications[9] was used to determine arabinoxylans (AX) content in wheat flour. Total arabinoxylans (TAX) content as xylose equivalents was determined by using an extraction reaction reagent that included acetic acid, hydrochloric acid and a coloring substance, phloroglucinol, that helped the UV spectrophotometer determine the levels of arabinoxylans. Reading of arabinoxylans were taken at 552 nanometers and 510 nanometers.

Digestibility of Wheat Grain: The digestibility of the wheat grain was determined by using an in vitro method[10]. Pancreatic enzymes such as a-amylase and amyloglucosidase were used to imitate the digestion of starch. In thirty minute intervals the levels of starch converted to glucose were measured at 510 nanometers by using a spectrophotometer. Levels of resistant starch, readily digestible starch, slowly digestible starch and hydrolytic index were determined.

Variables: The controls for all procedures were standards and blanks. The type of standard varied for each procedure. The independent variables were the wheat varieties. The dependant variable was the percentage of the nutritional composition for the specific nutrient.

Ancient	Modern
Emmer	Red Fife (1860)
Spelt	Thatcher (1935)
Einkorn	Neepawa (1969)
	CDC Teal (1991)
	Unity (2007)

Table 1. The modern wheat varieties (with registration year), and ancient wheat varieties used.

Analysis: This study used principal component analysis (PCA) to analyze the data collected. Through PCA, a visualization of the relationships amongst the different grain nutritional components was created. PCA also determined the similarities between the different wheat varieties by grouping them together.

RESULTS

Nutritional Composition:

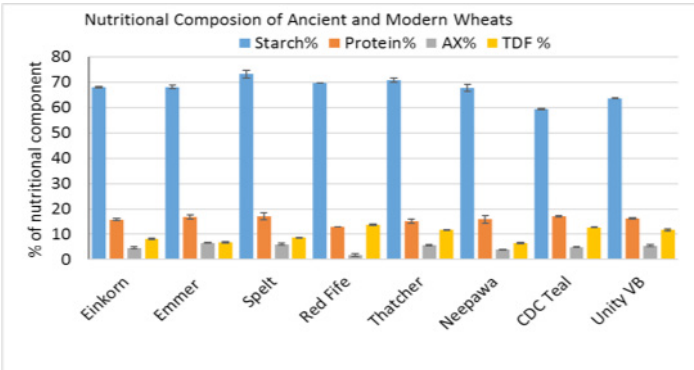


Figure 1. Representation of the different nutritional components.

Digestibility:

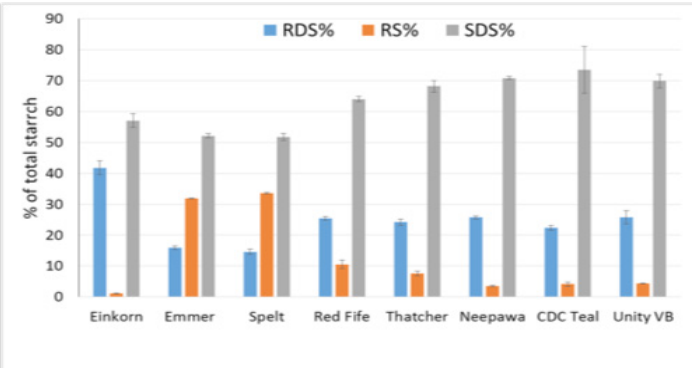


Figure 2. Resistant Starch (RS), Readily Digestible Starch (RDS),and Slowly Digestible Starch (SDS) for the wheat varieties.

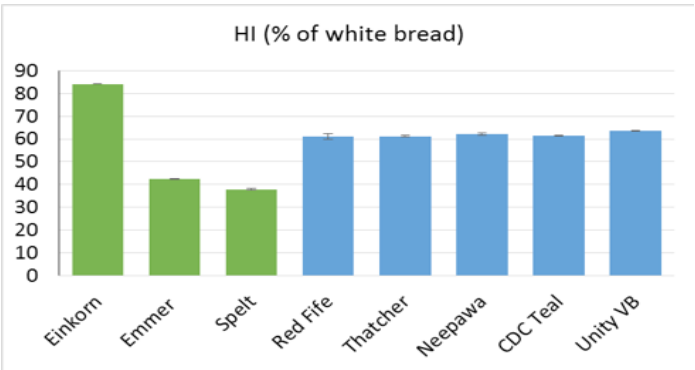
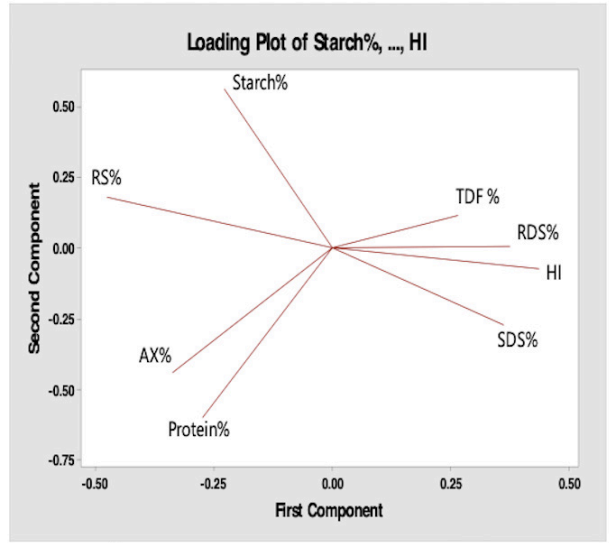


Figure 3. Hydrolytic index (HI) of the wheat varieties.

	Ancient Wheat	Modern Wheat
Starch%	69.79 (68.00 - 73.22)	66.29 (59.39 - 70.94)
Protein%	16.53 (15.78 - 17.08)	15.41 (12.80 - 17.03)
TDF%	7.93 (6.89 - 8.64)	11.29 (6.44 - 13.82)
TAX %	5.75 (4.66 - 6.60)	4.34 (1.73 - 5.58)
RDS %	24.12 (14.61-41.78)	24.70 (22.3-25.8)
RS %	22.21 (1.14-33.61)	6.0 (3.5-7.6)
SDS %	53.67 (51.79-57.08)	69.3 (64.0-73.5)
HI	54.81 (37.86-84.20)	61.9 (61.1-63.6)

Table 2. Averages of wheat types nutritional components. Maximum and minimum percentages for each wheat type.



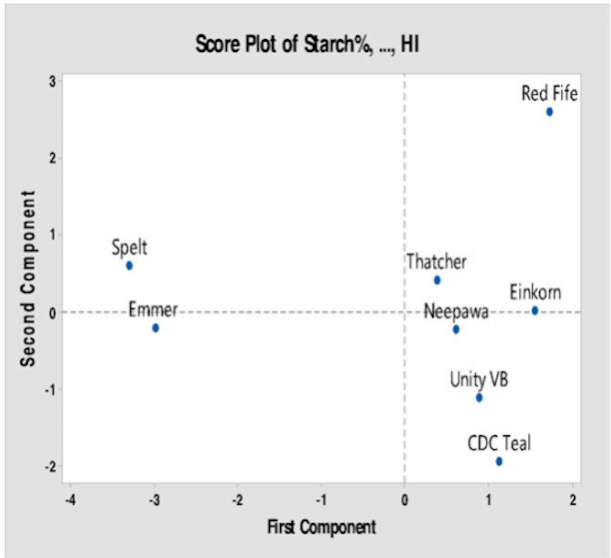


Figure 4. Principal component analyses to group grain nutritional constituents and wheat varieties to study their relationship.

Nutritional Composition:
There was little variation in the difference between maximum and minimum percentages of total starch, total protein and total arabinoxylans in both ancient and modern wheat. Higher variations were seen in the other nutrients.

Principal Component Analysis (PCA):
To study the relationship between different grain parameters and the wheat varieties, PCA analysis was done for grain constituents and wheat types. The total dietary fiber was related to readily and slow digestible starch and hydrolytic index. Whereas proteins and arabinoxylan concentrations were related to each other. Among the wheat varieties, Spelt and Emmer formed one group, while Einkorn wheat turned out to be in the same group as modern wheat varieties.

CONCLUSIONS

The results have shown that there are variations in the wheat varieties nutritional composition with no substantial change in grain composition of wheat over time and not specific to the wheat type. The grain nutritional components such as protein, dietary fiber and starch of ancient wheats are comparable to modern wheats. The principal component analysis demonstrates that there is not a strong correlation between the variations seen and the wheat types. The implication of this study is, it gives consumers an idea about ancient and modern wheat varieties nutritional composition in comparison to each other.

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DARSHANA LANKE

My name is Darshana Lanke. I am a grade 10 student in the French Immersion Program at Walter Murray Collegiate. I love learning languages and can speak 4 different languages (English, French, Hindi and Marathi). Some of my hobbies include singing, cooking, and knitting. Currently I am working on my level 6 Royal Conservatory Voice Exam. I also have an interest in social justice. Debate, Math, Mock Trials, Badminton and French speaking competitions are some of the activities I take part in. I have a passion for learning, especially in the field of science. I have been participating in science fairs since grade 7. I am a Canada-Wide Science Fair participant and medalist.