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Importance of ancient grains and their utilization in preparation of multi nutrient rich biscuits to meet the dietary requirements

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Abstract
A new approach to achieve optimal health status by promoting the state of well-being and possibly eliminating the risk of disease resulted in the development of various functional foods. With change in time Food industry has been striving to cater to the diverse range of population. The present work has been made by utilising the underutilised, more nutritious ancient grains like Quinoa, Jowar and Flax seed in preparing biscuits of exceptional high nutritive value. Biscuits were prepared by adding quinoa and Jowar at different levels and keeping flax seed constant (20%) and were compared. These were assessed for their nutritional composition as well as daily values. Biscuits prepared with quinoa, flax seed and Jowar in 40:40:20 was superior in protein(12.14%) dietary fiber (10.64%) Potaasium (299.72mg), calcium (74.20mg), Magnesium (123.98mg), Phosphorous (248.88mg) Iron (6.84mg) and Vitamin c (11.86mg).

Keywords: ancient grains, quinoa, flax seed, jowar, functional foods, nutritional composition, daily values

1. Introduction
Ancient Grains are the ones that have a long history of use and generally considered less changed by modern plant science practices. They have unique flavours; Visual interested due to the seed size, shape and color and is primarily used as whole grains-generally not refined Consumer interest is increasing slowly in utilization of these grains all over the world. Increased use in fine dining and now are found beyond natural foods section of supermarkets. Ancient grains are being used in modern ways. Product applications include bakery, pasta, extruded snacks, batters & breadings [1].
Consumption of foods made from refined grains (e.g., cookies, pasta, pastries, white bread) has increased and the health risk has been doubled not only to weight gain but to increased risk of insulin resistance and the metabolic syndrome features like low levels of HDL cholesterol, visceral obesity (the "apple shaped" body), high triglycerides, high blood pressure and allergy (gluten intolerance) [2]. Consumption of whole grains have protective action against all these illness. Among all the bakery products, Biscuits are the most popular food stuffs well cherished by all the population due to their long shelf life and low cost [3].
Quinoa pronounced as (keen-wah) is a pseudo cereal of the Andean regions of South America. Quinoa belongs to the *Chenopodiaceae* family, genus *Chenopodium* [4]. It is a good sources of protein (12 - 18 g/100 g on dry weight), fiber, vitamins (such as C, E and B complex) and important minerals (such as Fe, Ca, K, Mg, P and Zn). The Incas, who revered quinoa as sacred, called it the "mother of all grains". and the FAO considers it as a perfect food and has declared as one of the crops destined to offer food security in the 21st century and deemed 2013 as" International Year of Quinoa". Quinoa is considered "golden grain, because of its high nutritional value, NASA has considered it to integrate into the diet of the astronauts [5, 6].
Quinoa flour is low in gluten due the low contents of prolamines and glutamines and can be as a source for people with gluten intolerance (celiac disease).The low-allergy potential and relatively high digestibility made it a food of special interest in the diet of children and toddlers [7]
Quinoa seeds contain saponins, a toxic glycoside, are a bitter compound, present on the outer coating of seeds and must be removed before consumption. The mineral content of the seed is not affected on the removal of saponins by mechanical or chemical means [8].
The levels up to which quinoa flour can be added as a substitute have been reported as in bread (10–13%quinoa flour), noodles and pasta (30–40% quinoa flour), and sweet biscuits (60% quinoa flour) [9]. Viewing in the Indian perspective, Quinoa may be classified as "underutilized, despite its wide adaptability, and nutritional superiority [10].
Sorghum (Jowar) is a genus of plants in the grass family. Sorghum is a truly ancient grain. Sorghum remains found in the Nabta Playa archaeological site in the Western Desert, southern Egypt dating back to 8000 B.C. [11] is an important food crop in Africa, Central America, and South Asia, and is the "fifth-most important cereal crop grown in the world" according to the U.S. Grains Council. Sorghum is drought tolerant and resistant to water logging and grows in various soil conditions [12]. In a 100 g amount, raw sorghum provides 329 calories of energy, 72% carbohydrates, 4% fat and 11% protein Sorghum supplies numerous essential nutrients in rich content (20% or more of the Daily Value, DV), including protein, the B vitamins, niacin, thiamin and vitamin B6, and several dietary minerals, including iron (26% DV) and manganese (76% DV) [13].

Sorghum has the added advantage of being inherently gluten free and has been demonstrated to be safe for people with celiac disease. Sorghum is an excellent source of energy, mainly in the form of complex carbohydrate. Complex carbohydrate (fibers, starches) is usually slowly digested and therefore provides satiety and delayed hunger [14]. Traditionally this flour has been used as a cereal food to create pancakes, porridges, beer and flatbreads throughout different cultures, such as jowar roti in India. It can be added or substituted in any recipe that calls for flour like cakes, cookies, breads and muffins [15].

Flax seed, also known as linseed, is originated in the Middle East thousands of years ago which belongs to the family of *Linaceae*, of the genus of *Linum*, and botanically named as *Linum usitatissimum.* [16] It has been identified as a functional food, whose benefits to health are generally attributed to high concentrations of linolenic acids (omega-3) and lignins, as well as significant quantities of dietary fiber. Flax contains 20–40% soluble fiber (mucilage gums) and 60–80% insoluble fiber (cellulose and lignin).Soluble fiber helps regulate blood sugar and cholesterol levels. By feeding the beneficial bacteria in the digestive system it promotes digestive health. When mixed with water, the mucilage gums in flaxseeds become very thick. This, combined with the insoluble fiber content, makes flaxseeds a natural laxative. Consuming flaxseeds can help promote regularity, prevent constipation and reduce the risk of diabetes. Flaxseeds may be useful as a part of a weight loss diet [17, 18] present study is to include these less utilised, more nutritious raw materials quinoa, flax seed and jowar in preparing a well balanced, super nutritious and benefited food product suitable to all age groups and evaluation for its nutritional value.

2. Materials & Methods

2.1 Raw materials Collection and Preparation

Quinoa, Roasted Flax seed powder, jowar were procured from the local market. The other consumable products were obtained and they were as follows-fat, sugar.

2.1.1Preparation of Quinoa flour:

Quinoa seeds are washed in running water until no foam is seen since the outer layers contain saponins which impart bitter taste.

The water is allowed to drain for some time and the seeds are dried in a hot air oven maintained at 50˚c.The dried grains were ground to fine powder using electric grinder stainless steel and sifted through 60 mesh. The above prepared flour is used in required quantities for preparation.

2.2 Biscuit formulation and preparation

Three formulations of quinoa, jowar and flax seed biscuit were prepared. Each formulation varied by ratio of quinoa to jowar. Flax seed was kept as constant. For the preparation of biscuits, Fat and sugar were mixed until creamy. Next, quinoa flour, flax seed powder and jowar flour were put into the mixture of fat and sugar. They were uniformly mixed to obtain consistent dough. The dough was rolled out and cut using biscuit cutter. The biscuits were baked in Traditional Brick oven for 20 min.After baking, biscuits were cooled to room temperature, packed in polypropylene pouches and sealed for further analysis.

Treatments

- J1 - 20g Quinoa flour,60g Jowar flour,20g flax seed powder (20:60:20)
- J2 - 30g Quinoa flour,50g Jowar flour, 20g flax seed powder (30:50:20)
- J3 - 40g Quinoa flour,40g Jowar flour, 20g flax seed powder (40:40:20)

2.3 Nutritional Analysis

The moisture, ash, protein and fat of the biscuits were determined according to the standard AOAC methods [19]The carbohydrate content was determined by calculated difference and calorie value was estimated by multiplying proportion of protein, fat and carbohydrate by their factors. Crude Fiber was determined using AOAC method. Total dietary fibre (TDF) was analysed by following enzymatic gravimetric method. Vitamin C was determined using 2, 6, dichloroindophenol method. Minerals were analysed using ICP-OES.

2.4 Daily value of the product

The daily value is used for nutrition labelling which help the consumer make informed food choices. This represents both the terms Daily Reference Value (DRV) and Reference Daily Intake (RDI).These are developed by USFDA. This provides guide to the nutrients in one serving of food. These are based on a 2000 calorie diet for healthy adult.

The nutrients in the formulations are calculated for their Daily value.

3. Results and Discussion

The nutritive values of the three formulations were represented in the Table 1, Table 2 and Table 3. Moisture, Ash content, Fat, Protein, Crude fiber and Carbohydrates were represented in g/100g.Energy in kcal and Vitamin c in mg/100g.minerals are represented in mg/100g.

Table 1: Proximate composition of biscuits (per 100g)

Sample	Moisture (g)	Minerals (g)	Protein (g)	Fat (g)	Crude fiber (g)	Carbohydrates (g)	Energy (kcal)
J1	2.57±0.04	1.47±0.07	11.15±0.19	21.20±0.08	1.74±0.05	63.61±0.12	490±0.12
J2	3.05±0.04	1.55±0.06	11.69±0.18	22.24±0.07	1.99±0.06	61.47±0.17	493±0.19
J3	3.14±0.06	1.62±0.07	12.14±0.13	23.25±0.07	2.13±0.04	59.05±0.10	497±0.20

Table 2: Dietary fiber and Vitamin c of biscuits(per 100g)

Sample	Dietary fiber (g)	Vitamin-C (mg)
J1	9.14±0.06	7.64±0.04
J2	9.29±0.07	9.22±0.05
J3	10.64±0.06	11.86±0.04

Table 3: Mineral analysis of biscuits (per 100g)

Sample	Calcium (mg)	Potassium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)	Manganese (mg)	Zinc (mg)
J1	61.58	293.88	238.77	100.31	5.84	1.15	1.24
J2	70.54	296.63	245.69	112.78	6.21	1.25	1.51
J3	74.20	299.72	248.88	123.98	6.84	1.50	1.78

The moisture content in the three samples increased with the increase in quinoa flour and was found to be 3.14% maximum. This shows that the moisture in biscuits is controlled and is in the range required as per the specification of 5%.Low levels of moisture make the product hard and higher levels effect the shelf life of the product. The ash content which is the inorganic matter remained after the organic matter was removed by heat and which is an index of the mineral matter was found to be in between 1.47-1.62%.The protein content increased from J1 to J3 and was highest in J3 (12.14g).This could be attributed to the addition of quinoa flour which is a richest source of protein. This is in agreement with the work carried by [20].The dietary fiber content was high in three samples the maximum being 10.64%, this might be due to the addition of Jowar and flax seed which by nature have highest portions. Vitamin c has increased and this is due to the quiona added. This itself acts like a preservative and helps the product not to spoil quickly. The carbohydrates decreased from 63.61 to59.05%.These results are in agreement with [21] who said that with incorporation of quinoa flour there will be a decreases in the carbohydrate content and Energy has been increased in the samples which provide the highest calories.

The mineral content of the biscuits is remarkably high. The calcium content was 74.20mg/100g. Potassium content was highest in formulation J3 (299.72mg/100g).The phosphorous content was three fold the highest being 248.88mg/100g This is due to the addition of quinoa which has the minerals three folds more than other cereals [22-23]. The magnesium content was outstanding in all the three formulations in the range of 100.31-123.98mg/100g. The manganese content was high (1.50mg/100g).

The iron content in the samples were remarkably superior in the range of 5.84-6.84mg which is contributed by jowar which inherently has excellent amounts of iron content in it which helps in treating anaemic individuals.

The nutritional values of all the three formulations prepared from quinoa, flax seed and jowar in different proportions were remarkably greater. Among all the three formulations J3 had the highest mineral content, dietary fiber, protein as well as Vitamin c and was very appreciable.

The daily value for the three formulations is represented in Table 4, Table 5 and Table 6. Percent daily values are based on a 2,000 calorie diet

Table 4: daily value for J1

S. No	Food component	Product contains(per 100g)	Daily value %	Nutrient claims
1	Protein(g)	11.15	22	Excellent source
2	Dietary Fiber(g)	9.14	37	Excellent source
3	Phosphorous(mg)	238.77	24	Excellent source
4	Magnesium(mg)	100.31	25	Excellent source
5	Iron(mg)	5.84	32	Excellent source
6	Vitamin c (mg)	7.64	13	Good source

Table 5: Daily Value for J2

S. No	Food component	Product contains (per 100g)	Daily value %	Nutrient claims
1	Protein(g)	12.14	24	Excellent source
2	Dietary Fiber(g)	10.64	43	Excellent source
3	Phosphorous(mg)	248.88	25	Excellent source
4	Magnesium(mg)	123.98	31	Excellent source
5	Iron(mg)	6.84	38	Excellent source
6	Vitamin c (mg)	11.86	20	Excellent source

Table 6: Daily Value for J3

S. No	Food component	Product contains(per 100g)	Daily value %	Nutrient claims
1	Protein(g)	11.69	23	Excellent source
2	Dietary Fiber (g)	9.29	37	Excellent source
3	Phosphorous(mg)	245.69	25	Excellent source
4	Magnesium(mg)	112.78	28	Excellent source
5	Iron(mg)	6.21	35	Excellent source
6	Vitamin c (mg)	9.22	15	Good source

As per Food and Drug Administration, the nutrient claims are as follows

- "Good Source of"= Contains, 10% or more of Daily Value (DV) to describe protein, vitamins, minerals, dietary fiber, or potassium per reference amount.
- "High," "Rich In or "Excellent Source of"'= Contains 20% or more of the Daily Value (DV) to describe protein, vitamins, minerals, dietary fiber, or potassium per reference amount [24].

From the results it is evident that the prepared formulated biscuits J3 is an excellent source of Protein, dietary fiber, Phosphorous, Magnesium,Iron and Vitamin C where as JI,J2 are excellent source of Protein, dietary fiber, Phosphorous, Magnesium, Iron and good source of Vitamin C.

This study provides an insight about the importance of ancient grains and their contribution to superior nutritional profile which undoubtedly helps a wide range of population to experience a variety in their diet as well as meet the dietary requirements needed for their overall well being.

4. References

1. Rimm EB, Ascherio A, Grovannucci E, Spielgelman D, Stampfer MJ, Willet WC. Vegetable, fruits, and cereal fiber intake and risk of coronary heart desease among men. Journal of the American Medical Association. 1996; 275:447-451.
2. Williams PG. Evaluation of the evidence between consumption of refined grains and health outcomes. Nutr Rev. 2012; 70(2):80-99.
3. Iwegbue CMA. Metal contents in some brands of biscuits consumed in southern Nigeria. Am J Food Technol. 2012; 7:160-167.
4. Valencia-Chamorro SA. Quinoa. In: Caballero B.: Encyclopedia of Food Science and Nutrition. Vol. 8. Academic Press, Amsterdam, 2003, 4895-4902.
5. Ahamed NT, Singhal RS, Kulkarni PR, Pal M. A lesser-known grain, Chenopodium quinoa: review of the chemical composition of its edible parts. Food and Nutrition Bulletin. 1998; 19:61-70.
6. Ogungbenle HN. Nutritional evaluation and functional properties of quinoa (Chenopodium quinoa) flour. International Journal of Food Sciences and Nutrition. 2003; 54:153-158.
7. Eberhardt MV, Lee CY, Liu RH. Antioxidant activity of fresh apples. Nature. 2000; 405:903-904.
8. Scalbert A, Manach C, Morand C, Remesy C, Jimenez L. Dietary polyphenols and the prevention of diseases. Critical Reviews in Food Science and Nutrition. 2005; 45(4):287-306.
9. ALVAREZ-JUBETE L, *et al.* Polyphenol composition and in nitro antioxidant activity of amaranth, quinoa, buckwheat and wheat as affected by sprouting and baking.FoodChemistry,v. http://dx.doi.org/10.1016/j.foodchem. 2009-2010; 119:770-778.
10. The Times of India. Quinoa holds hopes for dry Anantapur. The Times of India., 2013.
11. Dahlberg JA, Wasylikowa K. Image and statistical analyses of early sorghum remains (8000 B. P.) from the Nabta Playa archaeological site in the Western Desert, southern Egypt. Vegetation History and Archaeobotany. 1996; 5:293-299.
12. Taylor JKN. Overview: Importance of sorghum in Africa. In: Afripro: Workshop on the Proteins of Sorghum and Millets: Enhancing Nutritional and Function Properties for Africa. Eds. P.S. Belton and J. R. N. Taylor. Pretoria, 204 www.africipro.org.uk, 2003, 1.
13. Rooney LW, Waniska RD. Sorghum food and industrial utilization. in: Sorghum: Origin, History, Technology, and Production. C. W. Smith and R. A. Frederiksen, Eds. John Wiley & Sons, Inc. New York, 2000, 689-750.
14. Connon JJ, Celiac disease. In Modern Nutrition in Health and Disease, Eds M. Shils JA. Olson & M. Shike. 8th edition, Lea & Febiger, Philadelphia, 1994, 1060-1065.
15. Mohammed NA, Ahmed IAM, Babiker EE. Nutritional evaluation of sorghum flour (*Sorghum bicolor L. Moench*) during processing of injera. Intl J Bio & Life Sci. 2010; 6(1):35-39.
16. Chan JK, McDonald BE, Gerrad JM, Bruce VM, Weaver BJ, Holub BJ. Effect of dietary alpha-linolenic acid and its ratio to linoleic acid on platelet and plasma fatty acids and thrombogenesis. Lipids. 1993; 28(9):811-817.
17. Oomah BD, Mazza G. Flaxseed products for disease prevention. In Mazza, G. (Ed). Functional Foods: Biochemical and Processing Aspects. Lancaster, PA: Technomic Publication Company Inc. 1998, 91-138.
18. Maillard V, Bougnoux P, Ferrari P. Omega 3 and Omega 6 fatty acids in breast adipose tissue and relative risk of breast cancer in a case-control study in Tours, France. International Journal of Cancer. 2002; 98(1):78-83.
19. AOAC-Official methods of analysis, 20th edition, Dr. George Latimer, Jr. Editor, 2016.
20. Atef AI, Abou-Zaid SY, El-Faham H. Wafaa, Emam H. Use of Quinoa Meal to Produce Bakery Products to Celiac and Autism Stuffs. International Journal of Science and Research. 2014; 3(9):1344-1354.
21. Repo-Carrasco-Valencia RA, EncinaRepo-Carrasco-Valencia RA, Encina CR, Binaghi MJ, *et al.* CR, Effects. Effects of roasting and boiling of quinoa, kiwicha and kaniwa on composition and availability of minerals in vitro J Sci Food Agric, 2010.
22. Bock MA. Minor constituents of cereals. In: Kulp, K., Ponte Jr, J.G. (Eds.), Handbook of Cereal Science and

Technology, second ed. Marcel Dekker Inc, New York, 2000, 479-504.
23. Frontela C, Ros G, Martínez C. Phytic acid content and "in vitro" iron, calcium and zinc bioavailability in bakery products: The effect of processing. Journal of Cereal Science. 2011; 54:173-179
24. Suzanne Nielsen S. Food Analysis Second Edition, Aspen Publishers, Inc. Gaithersburg, Maryland, 1998, 595.