# Quinoa: The current legislation in the United Kingdom and European Union.

**Delia Ojinnaka**

**School of Applied Science, London South Bank University, Borough Road, London SE1 0AA, United Kingdom.**

**Abstract**

In this chapter food safety control in relation to quinoa (*Chenopodium quinoa* Willd) as food and food ingredient was discussed and evaluated through a critical examination of the current statutory provisions at United Kingdom (UK) and European Union (EU) Levels. The risk if any, posed by quinoa seeds from production to consumption were identified and suggestions for compliance were made. Quinoa though novel in the UK and marketed loosely as superfood apparently does not warrant any specific (vertical) food safety control requirements and thus is not restricted by the Novel Food Regulation (EC) No. 258/97. This assertion is supported through the composition; the constituents are non-toxic, consumption of quinoa in South America dates to back to several centuries and there is no reported adverse food safety incident. However quinoa, like all foods must meet food safety requirements as stated in the Food Safety Act 1990 as amended and Regulation (EC) 178 /2002 on general food law.

**Keywords:** *Quinoa, EU food safety legislation, the Food Safety Act 1990, Regulation (EC) 178 / 2002, Novel Food Regulation (EC) No. 258/97.*

**\*Corresponding author. Tel.: 020-7815-6255; fax: 020-7815-7999. E-mail address: ojinnad@lsbu.ac.uk (D. Ojinnaka).**

|  |  |
| --- | --- |
|  |  |
|  |  |

1. **Introduction**

Quinoa (*Chenopodium quinoa* Willd) is an annual crop that originates from the Andes, South America, covering Argentina, Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela and with Peru and Bolivia having the most germplasm accession. It is currently cultivated in Spain (Herencia *et al.,* 1999*)* and Malawi (Maliro & Guwela, 2015*)* where the potential contribution of quinoa to food security and sustainability was explored. Quinoa is among the crop selected for food security consideration by the Food and Agriculture Organisation (FAO) (Jacobsen, 2003) as the protein quality of the seed is deemed to be better than those of cereals as it contains more s lysine and methionine than cereals (Fleming & Galwey, 1995) and furthermore, it can thrive in adverse agro-ecological conditions. Cultivation tests has been carried out with some success across the world (Bhargava *et al.,* 2007; Jacobsen *et al.,* 1994; Pulvento *et al*., 2010).

Quinoa grain has been used as food ingredients over several centuries; the grain is consumed as a staple and is widely used as ingredient in production of ‘chicha’ beer (Simmonds, 1965), breakfast foods and soups (Repo-Carrasco *et al.,* 2003). It may be used as an alternative to rice, beans, wheat and lentils. Its use in production of gluten-free flour confectionery is being explored.

Quinoa seed is making a gradual appearance in the United Kingdom (UK) food market, being sold as a super food / super grain under the umbrella of healthy and vegetarian food and consequently commanding a premium price, the average cost being about 80 pence per 100 gram thus 20% more than a regular basmati rice and much more than a long grain rice. At the moment it is a niche market and is sold on its own; white, red or mixed and also in combination with other grains; rice, wheat and cous and in production of vegetarian rolls and chips. Thus the range is wide and endless and versatility is attributable to the subtle aroma and acceptable texture. Acquired taste and familiarity are unnecessary. Quinoa seems to present a real alternative to conventional cereals such as wheat, oat, maize and rice as well as to traditional foods such as cous and pasta. It is readily adapted as a food ingredient in the United States and Europe (Schlick & Bubenhein, 1996).

The nutritional composition of quinoa is equally comparable (Figure 1) with those of rice and cous with quinoa being significantly lower in total carbohydrate and higher in fibre. The values are obtained from the nutrition information on the label of products sold in UK supermarkets and are based on the AOAC standard methods (Association of Official Analytical Chemists, 1990).

Figure 1 Comparative nutrition information for supermarket brand quinoa, cous and rice.

1. **EU food safety control and requirements**

The safety of evaluation of quinoa as food and food ingredient indicated that special control is unnecessary and quinoa seeds or grains are liable to the general food safety control. Food safety is one of the key issues of food control, from both the food producers and food law enforcement points of view, recognizing the equally important needs of distributors, retailers and of course, consumers. Success lies in the introduction and implementation of effective statutory and non-statutory systems of control, ranging from microbiological, chemical and physical safety. Modern food control is based on the precautionary principle, the scope ranging from farm to plate, including all stages of production, processing, delivery and the sale of foods. The principles of control based on prevention through self-regulation rather than detection and treatment.

Control exists at various levels; national, European Union (EU) and Global through the Codex Alimentarius Commission. In the UK control rests with the Food Standards Agency (FSA), Department of Health (DoH) and Department of Environment, Food and Rural Affairs (DEFRA). Similar function is performed at the EU level by the European Food Safety Authority (EFSA).

The safety and wholesomeness of food are of paramount importance to every consumer. There are several links between diet and longevity, ailment and wellness (Marcus, 2013, Aruoma, 2012 Benford, 2013, Clarke, *et al.,* 2015, Keeney & Butterfield 2015, Maderuelo-Fernandez *et al.,* 2015. Steel, *et al*., 2011). Specific foods, ingredients and the chemicals they contain can have a direct impact on health. The responsibility of assuring the safety of food lies primarily with government and the industry. In today’s food industry, all aspects of the production, storage and distribution of food must be effectively controlled, not only to assure safety and wholesomeness, but also to ensure efficient and consistent manufacture, at the lowest possible cost. In the meantime, consumers, in particular those of the developed nations are demanding a greater assurance of safety as well as more information on which to base their choice.

Overall, national and international legislation provide the basis for much of this control. A lot remains to be done, however, as globalization of the food market continues and as more and more food products are being distributed, sold and consumed in different parts of the world away from their countries of origin. Legislation is important aspect of food control and is one of the backbones food legislation is an essential element for an effective food safety and control. The module deals with legislative control at various levels, embracing national and European Union legislation and also international approaches to harmonisation. It also provides an awareness of the different types of food standards, both statutory and non-statutory and their implications for manufacturers, retailers and consumers. It also addresses the policy issues in sustainable food production and management.

Statutory control, irrespective of the source deals specifically with three main areas; public health, standards and labelling. Thus all food produced for sale must be safe and not injurious to health by meeting the food safety requirements as stated in section 7 of the Food Safety Act 1990 (FSA) as amended (Legislation.gov.uk) and article 14 of Regulation (EC) 278 / 2002 on the general principles and requirements of food law and procedures in matters of food safety (Europa. Eu.int/eur-lex/en/archive/2002). This Regulation has a direct application in all Member States. The Food Safety Act 1990 is a primary Act which provides the framework for all food legislation in Great Britain with the objective of ensuring that all food produced for sale is safe to eat and not misleadingly presented or labelled. These are expressly provided by section 7 which provides an offence of rendering foods injurious to health through; (a) addiction of any article or substance to the food (b) use of any article or substance as an ingredient in the preparation of the food, (c) abstraction of any constituent from the food and (d) subjecting the food to any other process or treatment. Injury means any impairment to health whether permanent or temporary and in its determination, probable and cumulative effects on the consumers are considered.

The FSA 1990 has been amended to bring it in line with Regulation (EC) 178/2002 in which similar provisions are made in articles 14 and 16 stating respectively that,

‘Food shall not be placed on the market if it is unsafe. 2. Food shall be deemed to be unsafe if it is considered to be: (a) injurious to health; (b) unfit for human consumption’ and ‘Without prejudice to more specific provisions of food law, the labelling, advertising and presentation of food or feed, including their shape, appearance or packaging, the packaging materials used, the manner in which they are arranged and the setting in which they are displayed, and the information which is made available about them through whatever medium, shall not mislead consumers’

Furthermore Article 19 states, ‘Without prejudice to more specific provisions of food law, the labelling, advertising and presentation of food or feed, including their shape, appearance or packaging, the packaging materials used, the manner in which they are arranged and the setting in which they are displayed, and the information which is made available about them through whatever medium, shall not mislead consumers’ Thus, it imposes a legal responsibility on food business operators to meet the food safety requirements.

The general principle in a nutshell is that, there is no 100% safety and 0% risk. Food businesses much have an effective food safety management system in place at all stages. The systems are generally based on hazard analysis critical control points (HACCP) and thus provides a means of self-regulation. These provisions ensure a high degree of protection of public health.

The commercial quinoa appears to be intrinsically compliant, though there is a concern about saponins which is found in the seed coats of the seeds and the values ranges from 0.9% to 1.4% in bitter varieties (Gee *et al.,* 1993; Ruales & Nair, 1993). Saponins are toxic glycosides with bitter taste; the presence of toxicants in foods may render the food injurious to health and thus breach the legal provision with consequent penalties as doing so is a strict liability criminal offence. Toxicity can be minimised by processing and washing with water. Additionally, washing reduces the bitterness (Gómez-Caravaca, *et al*., 2014) showed that sweet quinoa with a saponin content of less than 0.11% can be obtained by a pearling at an abrasion rate of 30%.

1. **EU food standards and labelling requirements**

There are minimum standards, which are set to ensure authenticity and control adulteration of foods offering protection against fraud. Adulteration may in some instances not present a health and safety hazard but involves the consumers being sold foods that are below the minimum standard. Typical examples are watering down of fruit juices, inaccurate or over-declaration of the meat content of comminuted products such as burgers and sausages and addition of corn syrup to pure honey. The composition and labelling of fruit juices and honey are regulated by vertical legislation namely; Council Directive 2001/112/EC relating to fruit juices and certain similar products intended for human consumption and Council Directive 2001/110/EC relating to honey, respectively. These EU directives are implemented in England respectively by the Fruit Juices and Fruit Nectars (England) Regulations 2013 and the Honey (England) Regulations 2015 (Legislation.gov.uk).There is little need for a vertical legislation relating Quinoa and quinoa as they are less susceptible to adulteration.

Labels are required to give the necessary information to enable the consumer to make an informed choices before buying the food and safe use of the food in consideration of cost, health, environment, society, faith and ethics. The regulations controlling labelling ensure that the labels are not misleading and conform to the given standards. Quinoa and quinoa products like other foods have to comply with Regulation (EU) 1169/2011 on the provisions of food information to the consumer (http://ec.europa.eu/food/safety/labelling\_nutrition/labelling\_legislation/index\_en.htm) which is implemented in England by the Food Information Regulation 2014. Article 9 and annex II listed the mandatory food information as shown (Table 1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | Table 1  The mandatory food information (Regulation (EU) 1169/2011) | |  | |
|  | | **Mandatory information** | | **Applicability to quinoa and quinoa productions** | |
| a | | the name of the food | | yes | |
| b | | ingredients listing | | no | |
| c | | substances causing allergy and intolerance listing | | no | |
| d | | quantitative ingredient declaration | | yes | |
| e | | net quantity | | yes | |
| f | | minimum durability date | | yes | |
| g | | special storage and / or conditions of use | | yes | |
| h | | the food business operator’s name and address | | yes | |
| i | | country of origin or place of provenance | | yes | |
| j | | for use instructions | | yes | |
| k | | alcohol content | | No for the grain and yes for the wine. | |
| l | | nutrition information | | yes | |

Quinoa as a single ingredient will not be required to comply with the ingredient listing but will comply when used as an ingredient. Annex II listed substances causing allergy or intolerance as; cereals containing gluten (namely, wheat, rye, barley, oats, spelt, kamut or their hybridised strains, crustaceans, fish eggs peanuts soybeans milk nuts (namely, almond, hazelnut, walnut, cashew, pecan nut, brazil nut, pistachio nut, macadamia nut and Queensland nut), celery, mustard, sesame seeds, sulphur dioxide and sulphites at levels above 10mg/kg or 10mg/litre expressed as SO2,  lupin and molluscs. Quinoa is gluten-free, hence does not need to be listed and contain allergen advice as long as has not treated with sulphites and sulphur dioxide.

The requirement for nutrition information in England comes into force in 2016 however nutrition labelling remains a mandatory requirement once a claim is made, schedule 7 of the Food Information Regulation 2014 stated that nutrition information should be provided where a nutrition or health claim is made. The nutrition information is supposed to justify the claim (Legislation.gov.uk, 2015). Nutrition labelling is provided by the Council Directive on nutrition labelling for foodstuffs (90/496/EEC) and nutrition and health claims are provided by **Regulation (EC) No 1924/2006 of the European Parliament and of the Council on nutrition and health claims made on foods.** The former provides for the format of a nutrition label whereas the latter defines nutrition and health claims under article 1 thus; ‘Nutrition claim means any claim which states, suggests or implies that a food has particular beneficial nutritional properties due to the energy it provides and/ or nutrient it contain’ . Similarly, health claim ‘means any claim that states, suggests or implies that a relationship exists between a food category, a food or one of its constituents and health’ and includes a ‘reduction of disease risk claim’ .

In relation to quinoa, possible claims may include; low in energy, low in sugar, high in protein and high in fibre but a closer examination of the composition suggests not, as the amounts of protein and fibre are not exceptional high and furthermore there is no concrete evidence to show that consumption of quinoa and quinoa products uniquely impacts on the physiology and health of the consumer. Any claim on quinoa, alluding to these proprieties may be a breach. The key requirements for a claim as made in the annex of Regulation (EC) No 1924/2006 of the European Parliament and of the Council on nutrition and health claims made on foods, as may be applied to quinoa is summarised (Table 2)**.**

**Table 2**

**Nutrition and Health Claims (Regulation (EC) No 1924/2006)**

|  |  |  |  |
| --- | --- | --- | --- |
| **The Claims** | **The Requirements** | **Composition of quinoa** | **Recommendation for a claim** |
| low energy | ≤ 40 kcal (170 kJ)/100 g for solids ≤ 20 kcal (80 kJ)/100 ml for liquids. | 662kJ /157 kcal | no |
| energy-reduced | ≤ 30 % energy reduction. | 662kJ /157 kcal | no |
| fat-free | ≤ 0.5 g of fat per 100 g or 100 ml. | 2.5 | no |
| low-fat | ≤ 3 g of fat per 100 g for solids or 1.5 g of fat per 100ml for liquids. | 2.5 | no |
| saturated fat-free | the sum of saturated fat and trans-fatty acids ≤ 0.1 g of saturated fat per 100 g or 100 ml. | 0.3 | no |
| low sugar | ≤ 5 g of sugar per 100 g for solids or 2.5 g of sugar per 100 ml for liquids. | 1.3 | yes |
| sugar-free | ≤ 0. 5 g of sugar per 100 g or 100 ml. |  | no |
| sodium-free or salt-free | ≤ 0.005 g of sodium, or the equivalent value for salt, per 100 g | 0.2 | no |
| low sodium/salt | ≤ 0.12 g of sodium, or the equivalent value for salt, per 100 g or per 100 ml. | 0.2 | no |
| very low sodium/salt | ≤ 0,04 g of sodium, or the equivalent value for salt, per 100 g or per 100 ml. | 0.2 | no |
| source of fibre | ≥ 3 g of fibre per 100 g or at least 1.5 g of fibre per 100 kcal. | 3.1 | possibly |
| high fibre | ≥ 6 g of fibre per 100 g or at least 3 g of fibre per 100 kcal. | 3.1 | no |
| source of protein | ≥ 12 % of the energy value of the food is provided by protein. | 5.0 | no |
| high protein | ≥ 20 % of the energy value of the food is provided by protein. | 5.0 |  |

From the table it is apparent that claims for low calories, low fat, low sugar, high protein and high fibre cannot be made as on average the values for quinoa do not meet the legal provisions. However a ‘source of fibre’ and low sugar claims can be made as the fibre content is within the legal limit.

1. **EU contaminants and residues in foods requirements**

The presence of contaminants and residues in foods above the maximum residue level (MRL), breaches the provisions of the Food Safety Act 1990 as amended, subsequent regulations, Regulation (EC) 178 /2002 and Commission Regulation (EC) No. 1881/2006 setting maximum levels for certain contaminants in foodstuffs and implemented by *the Contaminants in Food (England) Regulations 2013.*

Under the FSA 1990, it is an offence to render food injurious to health (S7) this may occur through the presence of contaminants and residues. In a similar way, states that, ‘Food shall not be placed on the market if it is unsafe and shall be deemed to be unsafe if it is considered to be injurious to health and unfit for human consumption’. Article 1 the Commission Regulation (EC) No. 1881/2006. The foodstuffs listed in the Annex shall not be placed on the market where they contain a contaminant listed in the Annex at a level exceeding the maximum level set out in the Annex (COMMISSION REGULATION (EC) No 1881/2006).

The levels set for each contaminant or residue is deemed to be safe and presents no toxicological hazard for human health. Safety is further assured by the fact that MRL values are usually less than the acceptable daily intake (ADI) and tolerable daily intake (TDI). Foods may contain contaminants and residues which may be carcinogenic, genotoxic and irritant. For example, Sinhaand Caporaso (1999) showed that diet is a key factor in cancer development. A wide range of chemicals are used to improve agricultural yield through pest control, disease control and growth enhancement can be toxic.

Human exposure to contaminants and residues is usually through consumption of contaminated foods and environment. Food and food products are exposed to chemical contaminants through agricultural and non-agricultural industries. Contaminants from the environmental sources may contaminant the soil and water which in turn will contaminant crops and residues may remain in the crops.

Residues are defined as chemicals that are present in food materials as a result of treatment of the plant and animal sources with some chemical compounds. Typical examples are the agrochemicals such as pesticides, fertilisers, growth hormones and therapeutic drugs. Consequently, these residues may be present in the diets of human. Residues may include the parent compounds and their metabolites. The toxicity of the parent compounds may differ from that of their metabolites

Contamination may also occur during production, processing, preparation, treatment, packaging, transport or holding of the foodstuffs. Quinoa like other grains, nuts and fruits such as maize, groundnut, rice and soya beans is susceptible to fungal growth and thus may contain mycotoxins which cause mycotoxicosis in animals including human. Aflatoxins are of major concern because of their potency, they are secondary metabolite of the fungus *Aspergillus flavus, Aspergillus nominus* and *Aspergillus parasiticus.* Aflatoxins are very toxic, mutagenic, teratogenic and carcinogenic compounds (Ellis *et al*., 1991). Typical effects are damage to the liver, kidney and the nervous system. There is a strong link between aflatoxins and human hepatic cancer. Human exposure to aflatoxins is usually through consumption of contaminated foods. Aflatoxins are one of the major contaminants of food world-wide. Different legislative controls are in place to limit the level of aflatoxins in foods. The general trend is for developed countries to set lower tolerance levels than developing countries. The tolerance level ranges from 5 µg kg-1 to 30 µg kg-1. Quinoa and quinoa products are susceptible to chemical contaminations at all stages, from farm to plate. Hence these regulatory controls will apply.

1. **Conclusion**

This review concludes that commercial quinoa and quinoa products as sold and consumed in the United Kingdom and Europe Union do not require a vertical legislation as long as they comply with the provisions of the Food Safety Act 1990 as amended and Regulation (EC) 178 / 2002 on the general principles and requirements of food law and procedures in matters of food safety. Furthermore, the European Commission Novel Food Catalogue stated that quinoa does not require authorisation under the Novel Food Regulation (EC) 258/97 as it is widely consumed and to a great extent before the legislation came into force on 15th of May 1997. No safety evaluation is required though assessment of the composition showed that the outer skin contains saponins a toxic and bitter glycoside. Toxicity and bitterness are reduced by processing (Gómez-Caravaca, *et al*., 2014), it has been shown that, the level of saponins can be drastically reduced by milling and washing with water. Quinoa is fairly high in fibre and a possible claim for high in fibre can be made. Similarly a claim for low in sugar and gluten-free can be made. The protein content is similar to that of many cereals; about 16% thus not warranting a claim in that regard. Compliance with the legislation concerning organic and genetically modified foods is also necessary for organic and genetically modified quinoa.

Quinoa as food and food ingredient posed no risk to public health, they are freely marketed and consumed in the United Kingdom and the trend is upwards and pushed by the consumers’ quest for something new, curiosity and eagerness to culinary experimentation.

**REFERENCES**

1. Association of Official Analytical Chemists (1990) Official methods of analysis. Arlington, USA: AOAC.
2. Aruoma, O. I., Coles, L. Stephen, Landes, B. and Repine, J. E. (2012) [Functional benefits of ergothioneine and fruit and vegetable-derived nutraceuticals: overview of the supplemental issue contents](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/S0091743512001077), *Preventive Medicine,*  54 (1) , pp.S4-S8.
3. Bhargava, A., Shukla, S. and Ohri, D. (2007) Genetic variability and interrelationship among various morphological and quality traits in quinoa (Chenopodium quinoa Willd.), *Field Crops Research* 101, 104-116.
4. [Benford, D.J. (2013) Risk assessment of chemical contaminants and residues in foods](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/B9780857092458500088), *Persistent Organic Pollutants and Toxic Metals in Foods,* pp. 173-187.
5. Clarke, R., Connolly, L., Frizzell, C. & Elliott C.T. (2015) [Challenging conventional risk assessment with respect to human exposure to multiple food contaminants in food: A case study using maize,](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/S0378427415300102) *Toxicology Letters*,  238, (1),  pp, 54-64.
6. Europa. Eu.int/eur-lex/en/archive/2002:http://eur-lex.europa.eu/collection/eu-law.html [Accessed: 21st October 2015].
7. Fleming, J.E., Galwey, N.W., (1995) Quinoa (Chenopodium quinoa) In: Williams, J.T. (Ed.), *Cereals and Pseudocereals*. Champman & Hall, London, pp. 383.
8. Gee, J. M., Price, K. R., Ridout, C. L., Wortley, G. M., Hurrel, R. F. and Johnson, I. T. (1993) Saponins of Quinoa (Chenopodium Quinoa): Effects of processing on their abundance in quinoa products and their biological effects on intestinal mucosal tissue, *Journal of the Science of Food and Agriculture*, 63, pp. 201–209.
9. Gómez-Caravaca, A. M., Lafelice, G., Verardo, V., Marconi, E. and Caboni, M. F. (2014) [Influence of pearling process on phenolic and saponin content in quinoa (Chenopodium quinoa Willd)](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/S0308814614001976), *Food Chemistry*,  157, pp. 174-178.
10. Herencia, L.I., Alia, M., Urbano, P., Gonzalez, J.A., (1999) Quinoa Crop (*Chenopodium quinoa* Willd.) in the central region of Spain, *Rural life,* pp. 28-33.
11. Jacobsen, S.-E., Jørgensen, I., Stølen, O. (1994) Cultivation of quinoa (Chenopodium quinoa) under temperate climatic conditions in Denmark, *Journal of Agricultural Science* 122, pp. 47-52.
12. Jacobsen, S.-E. (2003), The worldwide potential of quinoa (Chenopodium quinoa Willd.), *Food Reviews International* 19, pp.167-177.
13. Keeney, J. T. Butterfield, D. A. (2015) [Vitamin d deficiency and Alzheimer disease: common links](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/S0969996115300048) neurobiology of disease, in press, corrected proof, [available online 6 July 2015].
14. Legislation.gov.uk, 2015: <http://www.legislation.gov.uk/ukpga> [Assessed: 21st October 2015]
15. Maderuelo-Fernandez, J.A., Recio-Rodríguez, J. I., Patino-Alonso, M. C., Pérez-Arechaederra, D., Rodriguez-Sanchez, E., Gomez-Marcos, M. A. and García-Ortiz, L. (2015) [Effectiveness of interventions applicable to primary health care settings to promote mediterranean diet or healthy eating adherence in adults: a systematic review](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/S009174351400485X), *Preventive Medicine*,  76, pp. S39-S55.
16. Maliro F.A. & Guwela V.  (2015) Chapter 9 Quinoa Breeding In Africa: History, Goals And Progress Quinoa: Sustainable production, variety improvement and nutritive value in agroecological systems [Kevin Murphy](http://www.worldcat.org/search?q=au%3AMurphy%2C+Kevin&qt=hot_author) & [Janet Matanguihan](http://www.worldcat.org/search?q=au%3AMatanguihan%2C+Janet%2C&qt=hot_author), (Ed), Hoboken, New Jersey: Wiley Blackwell.
17. Marcus, J.B. (2013) [Diet and disease: healthy choices for disease prevention and diet management: practical applications for nutrition, food science and culinary professionals](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/B9780123918826000091), *Culinary Nutrition,*  pp. 371-430.
18. Pulvento, C., Riccardi, M., Lavini, A., d’Andria, R., Iafelice, G. and Marconi, E. (2010) Field trial evaluation of two Chenopodium quinoa genotypes grown under rain-fed conditions in a typical Mediterranean environment in South Italy. *Journal of Agronomy and Crop Science* 196, pp.407-411.
19. Repo-Carrasco, R., Espinoza, C., Jacobsen, S.-E. (2003) Nutritional value and use of the Andean crops quinoa (Chenopodium quinoa) and kañiwa (Chenopodium pallidicaule). *Food Reviews International,* 19, pp.179-189.
20. Ruales, J., & Nair, B. M. (1993) Saponins, phytic acid, tannins and protease inhibitors in quinoa (Chenopodium quinoa, Willd) seeds, *Food Chemistry*, 48, 137–143.
21. Schlick, G. and Bubenhein, D.L. (1996) Quinoa: Candidate crop for NASA’S controlled ecological life support system. In: Janick J (Ed.) *Progress in new crops*. ASHS Press Arlington VA, pp. 632-640.
22. Simmonds, N.W. (1965) The grain chenopods of the tropical American highlands, *Econ. Bot.,* 19, pp. 223-235.
23. Sinha, R. and Caporaso, N. (1999) Diet, genetic susceptibility and human cancer etiology, *J Nutrition*, 129 pp. 556s-559s.
24. Steele, M., Dow, L. and Baxter, G. (2011) [Promoting public awareness of the links between lifestyle and cancer: a controlled study of the usability of health information leaflets](http://0-www.sciencedirect.com.lispac.lsbu.ac.uk/science/article/pii/S1386505611001766), *International Journal of Medical Informatics,*80, (12),  pp. E214-E229.