

Nutritional characterization of Quinoa from Brazilian variety BRs Piabiru

Caracterização nutricional da Quinoa da variedade brasileira BRs Piabiru

DOI:10.34117/bjdv6n11-661

Recebimento dos originais: 30/10/2020

Aceitação para publicação: 30/11/2020

Antonio Manoel Maradini Filho

Doctor of Food Science and Technology

Professor, Department of Food Engineering / Federal University of Espírito Santo
Endereço: Alto Universitário s/n, Campus Universitário, Guararema, Alegre-ES, Brazil
E-mail: antonio.maradini@ufes.br

João Tomaz Da Silva Borges

Doctor of Food Science and Technology

Professor, Department of Nutrition and Dietetics / Federal Institute of Education, Science and
Technology of Minas Gerais, Campus of São João Evangelista
Endereço: Av. Primeiro de Junho, 1043, Centro, São João Evangelista-MG, Brazil

Helena Maria Pinheiro Sant'ana

Doctor in Food Science

Professor, Department of Nutrition and Health / Federal University of Viçosa
Endereço: Av. Peter Henry Rolfs s/n, Campus Universitário, Viçosa-MG, Brazil

José Benício Paes Chaves

Doctor in Food Science

Professor, Department of Food Technology / Federal University of Viçosa
Endereço: Av. Peter Henry Rolfs s/n, Campus Universitário, Viçosa-MG, Brazil

Eber Antonio Alves Medeiros

Doctor of Plant Physiology

Manager of the Packaging Laboratory, Department of Food Technology / Federal University
of Viçosa
Endereço: Av. Peter Henry Rolfs s/n, Campus Universitário, Viçosa-MG, Brazil

Monica Ribeiro Pirozi

Doctor in Grain Science and Industry

Professor, Department of Food Technology / Federal University of Viçosa
Endereço: Av. Peter Henry Rolfs s/n, Campus Universitário, Viçosa-MG, Brazil

ABSTRACT

Quinoa stands out for its high resistance to adverse weather and soil conditions and, above all, for its high nutritional value. It surpasses most cereals in the amount of proteins, fats, fibers, vitamins and minerals, presenting a greater balance in the distribution of essential amino acids. In addition to containing high nutritional quality, quinoa is also characterized by being gluten-free, enabling a greater variety and offer of more nutritious food products suitable for people with celiac disease. Despite all these characteristics, the use and knowledge about quinoa is still little in Brazil due to the high cost of imported grain and the lack of knowledge of its benefits by the majority of the Brazilian population, with its industrialization and commercialization still very limited. The aim of this work was to evaluate nutritional quality through analysis of vitamins and carotenoids of the quinoa of the BRS Piabiru variety, developed and adapted to the conditions of the Brazilian savanna (Cerrado). Wholemeal quinoa flour showed high concentrations of carotenoids and vitamins, especially niacin and tocopherols, showing their potential nutritional value, especially when compared to the flours of other cereals commonly used in human consumption.

Keywords: *Chenopodium quinoa* Willd, pseudocereal, vitamins, nutritional value, gluten free.

RESUMO

O Quinoa se destaca por sua alta resistência a condições climáticas e do solo adversas e, sobretudo, por seu alto valor nutricional. Ela supera a maioria dos cereais na quantidade de proteínas, gorduras, fibras, vitaminas e minerais, apresentando um maior equilíbrio na distribuição de aminoácidos essenciais. Além de conter alta qualidade nutricional, a quinoa também se caracteriza por ser livre de glúten, permitindo uma maior variedade e oferta de produtos alimentares mais nutritivos e adequados para pessoas com doença celíaca. Apesar de todas estas características, o uso e o conhecimento sobre a quinoa ainda é pouco no Brasil devido ao alto custo dos grãos importados e ao desconhecimento de seus benefícios pela maioria da população brasileira, com sua industrialização e comercialização ainda muito limitada. O objetivo deste trabalho foi avaliar a qualidade nutricional através da análise das vitaminas e carotenóides da quinoa da variedade BRS Piabiru, desenvolvida e adaptada às condições da savana brasileira (Cerrado). A farinha integral de quinoa mostrou altas concentrações de carotenóides e vitaminas, especialmente niacina e tocoferóis, mostrando seu valor nutricional potencial, especialmente quando comparada às farinhas de outros cereais comumente utilizados no consumo humano.

Palavras-chave: *Chenopodium quinoa* Willd, pseudocereais, vitaminas, valor nutricional, sem glúten.

1 INTRODUCTION

Quinoa is originated from the Andes Mountains, cultivated millions of years ago by the local population and was rediscovered by the scientific community, due to its high nutritional value as a food. It is considered a “pseudocereal”, being its structure and way of use similar to cereals, and its grain can be ground and transformed into flour (BORGES et al., 2013; DAKHILI et al., 2019).

Its composition in essential amino acids is superior to most cereals and comparable to milk casein, in addition to the absence of gluten-forming proteins, which makes its use interesting for people with celiac disease. It presents relevant amounts of vitamins such as thiamine, riboflavin, niacin, pyridoxine and vitamin E, as well as minerals such as calcium, phosphorus, potassium, magnesium,

iron and zinc (STIKIC et al., 2012; TURKUT et al., 2016; VILCACUNDO; HERNÁNDEZ-LEDESMA, 2017).

In Brazil, its consumption is still quite limited due to the high cost of imported grain, and the lack of information presented by the majority of the population. Making quinoa popularly known to the Brazilian population will require extensive disclosure of information about its nutritional value and appropriate social marketing campaigns. Therefore, studies are needed to increasingly investigate the technological feasibility of growing quinoa in Brazil and also the nutritional and functional characteristics of new varieties. The aim of this work was to evaluate the nutritional characteristics of BRS Piabiru quinoa, the first variety of quinoa developed and adapted to Brazilian conditions by EMBRAPA Cerrados.

2 MATERIAL AND METHODS

The present research was carried out at the Vitamin Analysis Laboratory of the Department of Nutrition and Health of the Federal University of Viçosa (UFV). Samples were also sent to the ITAL Food Science and Quality Center (Campinas, SP), to determine thiamine, riboflavin and niacin. Quinoa grains (*Chenopodium quinoa* Willd.) of the variety BRS Piabiru vintage 2013, Lot BSB-004/13, supplied by EMBRAPA Cerrados, Planaltina, DF, were used.

The occurrence and levels of carotenoids and the eight homologues of vitamin E were determined by HPLC using a Shimadzu chromatograph (model SCL-10AT VP, Japan), according to procedures by Maradini Filho (2014). Thiamine, riboflavin and niacin were carried out according to the methodologies MA-CQ.036 and MA-CQ.037 of ITAL (Campinas, SP), based on methods 942-23 and 970-65 of AOAC (1998).

3 RESULTS AND DISCUSSION

Table 1 shows the concentration of vitamins and carotenoids in the whole quinoa flour of the BRS Piabiru variety used in this work.

Table 1 – Concentration of vitamins and carotenoids from the whole quinoa flour of the BRS Piabiru variety (mean \pm standard deviation).

Componentes		*(wb)	** (db)
Vitamins	Thiamine (mg 100 g ⁻¹)	0,12 \pm 0,01	0,13 \pm 0,02
	Riboflavin (mg 100 g ⁻¹)	0,03 \pm 0,01	0,03 \pm 0,01
	Niacin (mg 100 g ⁻¹)	11,06 \pm 0,16	12,35 \pm 0,18
	α -tocopherol (mg 100 g ⁻¹)	1,25 \pm 0,06	1,39 \pm 0,07
	β -tocopherol (μ g 100 g ⁻¹)	56,66 \pm 6,13	63,27 \pm 6,85
	γ -tocopherol (μ g 100 g ⁻¹)	47,63 \pm 0,09	53,19 \pm 0,10
	γ -tocotrienol (μ g 100 g ⁻¹)	9,64 \pm 0,19	10,76 \pm 0,21
	Total vitamin E (mg 100 g ⁻¹)	1,36 \pm 0,05	1,52 \pm 0,06
Carotenoids	β -carotene (μ g 100 g ⁻¹)	38,36 \pm 5,45	42,84 \pm 4,97
	Lutein (μ g 100 g ⁻¹)	54,56 \pm 2,84	60,92 \pm 3,17
	Zeaxanthin (μ g 100 g ⁻¹)	15,46 \pm 0,83	17,26 \pm 0,93
	Sum of carotenoids	108,38 \pm 6,90	121,02 \pm 7,70

*wb: wet base; and **db: dry base.

The levels of B vitamins observed in the BRS Piabiru quinoa variety differed from the values reported by Ruales and Nair (1993), USDA (2015) and by the Miranda et al. (2011). The concentrations of thiamine and, mainly, riboflavin were much lower than the values reported by these authors. Nevertheless, the levels of niacin found were practically eight times higher when compared to the values observed by the authors mentioned.

Palombini et al. (2013), evaluating the tocopherol content in quinoa grains of the BRS Piabiru variety, obtained values of 1.16 mg 100 g⁻¹ of α -tocopherol and 1.08 mg 100 g⁻¹ for the sum of β and γ -tocopherols. The content of α -tocopherol observed by the authors was slightly lower than that obtained in this study for the same variety of quinoa grains, however the content of the sum of β and γ -tocopherols was well above that the one obtained in this research.

The levels of β -carotene in quinoa grains observed in this research were higher than those reported by the USDA (2015), while the amounts of lutein + zeaxanthin were lower than those reported by the American Agency.

There was a great variation in the concentrations of the main vitamins present in the quinoa grains obtained not only in this work but also by several authors. This variation can be attributed to differences in the methodologies used, as well as genetic, climatic and cultural factors.

4 CONCLUSION

The whole quinoa flour exhibited expressive values of niacin, total vitamin E and carotenoids, showing its nutritional value. These results allow to infer about the nutritional superiority of this grain in relation to other cereals flours.

ACKNOWLEDGEMENTS

The authors would like to thank the National Council for Scientific and Technological Development of Brazil (CNPq), the Minas Gerais State Research Support Foundation (FAPEMIG) and the Coordination for the Improvement of Higher Education Personnel (CAPES) for granting financial supports.

REFERENCES

- AOAC. ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. **Official methods of analysis of AOAC international**. 16th ed. Gaithersburg, USA, 1998.
- BORGES, J. T. S.; VIDIGAL, J. G.; SOUSA e SILVA, N. A.; PIROZI, M. R.; PAULA, C. D. Caracterização físico-química e sensorial de pão de forma contendo farinha mista de trigo e quinoa. **Revista Brasileira de Produtos Agroindustriais**, v. 15, n. 3, p. 305-319, 2013.
- DAKHILI, S.; ABDOLALIZADEH, L.; HOSSEINI, S. M.; SHOJAEI-ALIABADI, S.; MIRMOGHATAIE, L. **Quinoa protein: Composition, structure and functional properties**. *Food Chemistry*, v. 299, Art. 125161, 2019.
- MARADINI FILHO, A.M. **Caracterização físico-química, nutricional e fatores antinutricionais de quinoa da variedade brasileira BRS Piabiru**. Orientadora: Mônica Ribeiro Pirozi. 2014. 202 p. Tese (Doutorado em Ciência e Tecnologia de Alimentos) – Universidade Federal de Viçosa, Viçosa, MG, 2014.
- MIRANDA, M.; VEGA-GALVEZ, A.; URIBE, E.; LÓPEZ, J.; MARTINÉZ, E.; RODRÍGUEZ, M. J.; QUISPE, I.; SCALA, K. Physico-chemical analysis, antioxidant capacity and vitamins of six ecotypes of chilean quinoa (*Chenopodium quinoa* Willd). **Procedia Food Science**, v. 1, p. 1439-1446, 2011.
- PALOMBINI, S. V.; CLAUS, T.; MARUYAMA, S. A.; GOHARA, A. K.; SOUZA, A. H. P.; SOUZA, N. E.; VISENTAINER, J. V.; GOMES, S. T. M.; MATSUSHITA, M. Evaluation of nutritional compounds in new amaranth and quinoa cultivars. **Food Sci. Technol.**, v.33, n.2, p.339-344, 2013.
- RUALES, J.; NAIR, B.M. Content of fat, vitamins and minerals in quinoa (*Chenopodium quinoa* Willd) seeds. **Food Chemistry**, v. 48, n. 2, p. 131-136, 1993.
- STIKIC, R.; GLAMOCLJIA, D.; DEMIN, M.; VUCELIC-RADOVIC, B.; JOVANOVIC, Z.; MILOJKOVIC-OPSENICA, D.; JACOBSEN, S.-E.; MILOVANOVIC, M. Agronomical and nutritional evaluation of quinoa seeds (*Chenopodium quinoa* Willd.) as an ingredient in bread formulations. **Journal of Cereal Science**, v. 55, n. 2, p. 132-138, 2012.
- TURKUT, G. M.; CAKMAK, H.; KUMCUOGLU, S.; TAVMAN, S. **Effect of quinoa flour on gluten-free bread batter rheology and bread quality**. *Journal of Cereal Science*, v. 69, p. 174-181, 2016.
- USDA. United States Department of Agriculture. **Composition of Foods Raw, Processed, Prepared USDA National Nutrient Database for Standard Reference, Release 27**. Jun. 2015. Available in: <<https://data.nal.usda.gov/dataset/composition-foods-raw-processed-prepared-usda-national-nutrient-database-standard-reference-release-27>>. Access in: 28 Aug. 2020.
- VILCACUNDO, R.; HERNÁNDEZ-LEDESMA, B. Nutritional and biological value of quinoa (*Chenopodium quinoa* Willd.). **Currente opinion in Food Science**, v. 14, p. 1-6, 2017.