MedCrave
Step into the World of Research

Horticulture International Journal

Short Communication

Open Access

CrossMark

Quinoa saponins, biological controller against *Cercospora coffeicola* and *Moniliophthora roreri*

Abstract

An extract rich in saponins obtained from quinoa residues showed in vitro anti-fungal activity against the coffee phytopathogen Cercospora coffeicola, with an antifungal index of inhibition (AI) of 22.39 ± 4.5% at 120 mg/mL, and against the cocoa phytopathogen Moniliophthora roreri, with an AI of 55.8 ± 1.6% at 60 mg/mL. The results showed a potential of this saponin-extract for the biological control of these phytopathogens.

Keywords: *theobroma cacao L, coffea arabica, chenopodium quinoa, quinoa saponins, cercospora coffeicola, moniliophthora roreri*

Volume 5 Issue 2 - 2021

Cervando Gutierrez Foronda, Marybel Lozano, Lily Salcedo Ortiz
Laboratorio de Bioorgánica, Instituto de Investigaciones Químicas, UMSA, Campus Universitario de Cota Cota, Bolivia

Correspondence: Lily Salcedo Ortiz, Laboratorio de Bioorgánica, Instituto de Investigaciones Químicas, UMSA, Campus Universitario de Cota Cota Edificio de la FCPN c. Andrés Bello y c. 27 s/n, CP 303 La Paz, Bolivia, Email pribiet2004@gmail.com

Received: June 18, 2020 | **Published:** March 12, 2021

Introduction

Bolivia is distinguished for being one of the main exporters of organic quinoa (Chenopodium quinoa Willd) around the world, grains with high nutritional value. The quinoa contents saponins which are located mainly in the episperm of the grain, given them a bitter taste for which the quinoa husk must be removed before human consumption producing residues with high saponin contents.

Quinoa saponins extracts have been studied by their potential biopesticide properties, showing antifungal activity against Botrytis cinerea and Cercospora beticola,[1,2] molluscicidal activity against the snail that affects rice crops.[3] In addition, extracts of saponin from quinoa have been registered by the Environmental Protection Agency (EPA) as biopesticide, basically intended for the control of fungi and viral diseases.[4]

In recent decades, the market for organic products has increased, particularly in South America. These products include Bolivian coffee and Amazon Cacao. Coffee production is often affected by losses due to the wide variety of diseases caused by phytopathogen fungus such as Cercospora coffeicola it may cause several lesions on leaves as brown spots and defoliation.[5] Cacao production yield is affected by Moniliophthora roreri which cause moniliasis of cacao a devastating disease.[6]

There are strategies to control these fungi in coffee and cacao crops some of them are using synhtetic antifungal agents or artisanal preparation, friendly antifungal to control these crops are urgently needed in order to take care the soils and environment. In this sense this work wants to contribute with the in vitro antifungal evaluation of an extract rich in quinoa saponins against the coffee phytopathogen Cercospora coffeicola and the cocoa phytopathogen Moniliophthora roreri.

Obtaining saponins extract and preparation in potato dextrose agar PDA

100 g of quinoa husk were extracted with an aqueous solution of EtOH (100ml) for 3h under constant stirring at room temperature. The liquid extract was concentrated by rotary evaporation giving a dried extract with 50-60% of saponins.[7] Then, a solution of 9% of the saponin-extract were prepared at different concentrations in PDA in Petri dishes.

Isolation of pathogenic fungi

The pathogenic fungi Cercospora coffeicola was obtained from coffee leaves and Moniliophthora roreri from cacao pods infected in PDA medium, in Petri dishes, their development was optimized by applying photoperiods. Macro and microscopic features were used to verify pathogens.

Mycelial growth inhibition test

The determinations were performed in quadruplicate for each concentration and test fungus. The growth diameter (mm) of each microorganism was measured every 7 days, during the 21 days. At the end the antifungal index is calculated which using the formula:

$$AI = [1 - [((Da*0.5))/(Db*0.5)]* 100]$$

Da = Sample growth diameter

Db = Control growth diameter.

For statistical analysis, an ANOVA was performed using the General Linear Model and comparisons by the Dunnett method with respect to the control.

The macroscopic and microscopic characteristics (Figure 1) coincided with the expected characteristics.

Saponin obtained from Quinoa has been shown to produce a statistically significant inhibitory effect compared to controls, compared to Cercospora coffeicola and Moniliophthora, roreri, this effect is dependent on the time of exposure. Cercospora coffeicola tends to adapt much better to saponin concentrations as the days go by; being that at 21 days the only concentration that presents a statistically significant difference compared to the control is 120 mg / mL with an antifungal index of 22.39% (Table 1) (Table 2).

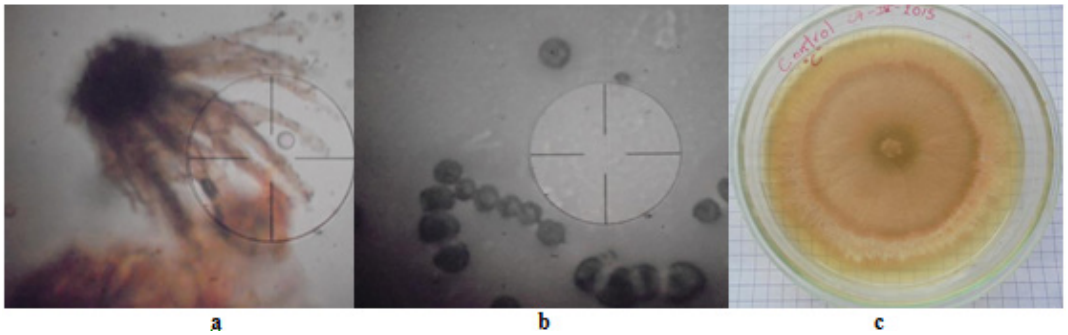

Figure 1 a. Conidia and hyphae of Cercospora coffeicola b. Moniliophthora roreri spores c. Moniliophthora roreri cultivation.

Table 1 Inhibition of mycelial growth of Cercospora coffeicola at different concentrations of saponin extract for 21 days

Mycelial inhibition in different periods						
	7 days		14 days		21 days	
Concentration mg/mL	Diámeter (mm)	AI (%)	Diámeter (mm)	AI (%)	Diámeter(mm)	AI (%)
120	14,25±1,25	29,63±6,17	20,25±0,85	34,15±2,78	39,00±2,27	22,39±4,52
60	14,00±0,71	30,86±3,49	25,50±0,96	17,07±3,11	45,25±2,29a	9,95±4,55a
30	16,75±0,48	17,28±2,36	26,25±1,31	14,63±4,28	44,50±1,26a	11,44±2,50a
15	14,75±0,75	27,16±3,70	26,25±0,75	14,63±2,44	45,25±1,25a	9,95±2,49 a
Control	20,25±0,48	0,00±2,36	30,75±1,11	0,00±3,61	50,25±1,31a	0,00±2,62a

The means of the columns with any letter are not statistically significant with respect to the control ($p < 0.05$), AI = Antifungal index

Table 2 Inhibition of mycelial growth of Moniliophthora roreri at different concentrations of saponin extract for 21 days

Mycelial inhibition in different period						
	7 days		14 days		21 days	
Concentration mg/mL	Diámeter(mm)	AI (%)	Diámeter(mm)	AI (%)	Diámeter(mm)	AI (%)
120	16,50±0,29	38,89±1,07	23,50±0,65	57,66±1,16	26,75±0,48	70,84±0,52
60	20,63±0,24	23,61±0,89	33,75±3,28	39,19±5,90	40,50±1,55	55,86±1,69
30	24,63±0,75a	8,80±2,76a	44,00±4,85a	20,72±8,73a	68,00±2,27	25,89±2,48
15	24,75±1,93a	8,33±7,15a	51,50±2,63a	7,21±4,74a	86,25±1,75a	5,99±1,91a
Control	27,00±1,91a	0,00±7,09a	55,50±1,94a	0,00±3,49 a	91,75±1,70a	0,00±1,85a

The means of the columns with any letter are not statistically significant with respect to the control ($p < 0.05$), AI = Antifungal index

The inhibitory effect of saponin against Moniliophthora, roreriincreases in relation to the time of exposure, reaching an AI greater than 50% with a saponin concentration of 60mg/mL at 21 days.

Acknowledgments

None.

Conflicts of interest

Authors declare no conflict of interest exists.

References

1. Stuardo M, San Martín RJI. Products, Antifungal properties of quinoa (Chenopodium quinoa Willd) alkali treated saponins against. *Botrytis cinerea*. 2008;27(3):296–302.
2. Zingarelli B, Hake PW, Denenberg A, et al. Sesquiterpene lactone parthenolide, an inhibitor of IkappaB kinase complex and nuclear factor-kappaB, exerts beneficial effects in myocardial reperfusion injury. *Shock*. 2002;17(2):127–134.
3. San Martín R., Ndjoko K, Hostettmann KJCP. Novel molluscicide against Pomacea canaliculata based on quinoa (Chenopodium quinoa) saponins. *Crop prodction.* 2008;27(3-5):310–319.
4. Heilmann J, Wasescha MR, Schmidt TJ. The influence of glutathione and cysteine levels on the cytotoxicity of helenanolide type sesquiterpene lactones against KB cells. *Bioorg Med Chem*. 2001;9(8):2189–2194.
5. Vale PAS, de Resende MLV, dos Santos Botelho DM, et al. Epitypification of Cercospora coffeicola and its involvement with two different symptoms on coffee leaves in Brazil. *Eur. J Plant Pathol*. 2021;159(2):399–408.
6. Phillips-Mora W, Castillo J, Krauss U, et al. Evaluation of cacao (Theobroma cacao) clones against seven Colombian isolates of Moniliophthora roreri from four pathogen genetic groups. *AGRIS*. 2005;54(4):483–490.
7. Lozano M, Tícona E, Carrasco C, et al. Cuantificación de saponinas en residuos de quinua real Chenopodium quinoa Willd. *Revista Boliviana de Química*. 2012;29(2):131–138.