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NOTA CIENTÍFICA

Does fruit cooling and seed film coating affect the germination potential of physalis?

¿El enfriamiento de los frutos y el recubrimiento de película de las semillas afecta al potencial de germinación de la uchuva?

Aniela Pilar Campos de Melo[1,*]; Carlos de Melo e Silva-Neto[1]; Alexsander Seleguini[1]; Paulo Marçal Fernandes[2]

[1] *Federal University of Goiás, Horticulture Sector, Goiânia, Goiás, Brazil.*
[2] *Federal University of Goiás, Phytosanitary Sector, Goiânia, Goiás, Brazil.*

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Abstract

Physalis (*Physalis peruviana* L.) is a native fruit of the Andes widely accepted in the national and international market. The berries have high commercial value, being very nutritious and tasty. Physalis cultivation in Brazil is currently expanding mainly southwards. Seeds carry out propagation. However, information concerning factors that could affect germination viability are scarce. Thus, the goal of this study was to assess the effects of storage and of film coating on the germination potential of physalis seeds. The experimental design was completely randomized in a 2x3 factorial, considering two fruit storage conditions (environment and cooling) x and three coating polymers to film-coat the seeds (Blue AG L-204® DISCO, Red AG L-203®DISCO, water), with five replications and one hundred seeds per plot. Germination was evaluated seven, 14 and 21 days after sowing to calculate the germination rate index. The physalis fruit cold storage for seven days does not affect the germination viability of the seeds. Seed coating increases the germination percentage and speed.

Keywords: *Physalis peruviana* L., cape gooseberry, physiological potential, coating polymers, storage.

Resumen

La uchuva (*Physalis peruviana* L.) es una fruta nativa de los Andes con gran aceptación en el mercado nacional e internacional. Las bayas tienen un alto valor comercial, siendo muy nutritivo y sabroso. El cultivo de la uchuva en Brasil se está expandiendo principalmente en el Sur. La propagación se realiza a través de semillas, sin embargo, en relación con la información sobre los factores que pueden afectar a la viabilidad de la germinación son escasos. El objetivo de este estudio fue evaluar los efectos de almacenamiento y recubrimiento de película sobre el potencial de germinación de semillas de uchuva. Se utilizó un diseño completamente aleatorizado, en el diseño factorial 2x3, con dos condiciones de almacenamiento de frutas (ambientales y refrigeración) x tres polímeros para recubrimiento de película de semillas (Disco Azul AG L-204®, Disco Rojo AG L-203®, agua), con cinco repeticiones y cien semillas por parcela. Se evaluó la germinación a 7, 14 y 21 días después de la siembra para el cálculo de la velocidad del índice de germinación. El almacenamiento en frío de las frutas en siete días no afecta a la viabilidad de la germinación de las semillas. El recubrimiento de semillas aumenta el porcentaje y la velocidad de la germinación.

Palabras clave: *Physalis peruviana* L., uchuva, potencial fisiológico, polímeros de recubrimiento, almacenamiento.

1. Introduction

The genus *Physalis* belongs to the family Solanaceae and has over 100 annual or perennial species, highlighting *Physalis peruviana* L. (Yildirim *et al.*, 2011). *P. peruviana* is native to the Andes, and is known as uchuva and cape gooseberry (Puente *et al.*, 2011). Colombia is the

* Autor para correspondencia
E-mail: aniela.pcdmelo@gmail.com (A. Campos de Melo).

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largest producer of physalis, and 50% of the production is exported to several countries, including Brazil (Bravo *et al*., 2014). Is a fruit with high commercial value, and a high acceptance in the national and international market (Ianckievicz *et al*., 2013).

The physalis plant is perennial, rustic and shrub sized. The fruit is an ovoid aromatic berry enveloped by a calyx that provides fruit protection from insects, birds, diseases and adverse weather (Puente *et al*., 2011; Valdenegro *et al*., 2012; Lima *et al*., 2012).

The physalis berries are consumed fresh or processed (Erkaya *et al.*, 2012) and have high K^{+}, Ca^{2+}, Mg^{2+}, Fe^{2+} (Rodríguez *et al.*, 2009), and bioactive substances (Rutz *et al*., 2012; Rop *et al*., 2012; Namiesnik *et al.*, 2013), such as phytosterols, polyphenols, physalins and high vitamins content (Correa *et al.*, 2013; Çakir *et al*., 2014). The physalins are anti-inflammatory, anti-allergic and anti-cancer (Puente *et al*., 2011; Zheng *et al*., 2012).

The propagation occurs through seeds, cuttings and micropropagation (Ianckievicz *et al*., 2013; Muniz *et al*., 2014). Seeds are more used due to satisfactory germination and the high amount of seeds (100 to 200) (Puente *et al*., 2011).

High quality seeds are essential for seedling production and the consequent establishment of the production system. However, information concerning the factors that may affect the physiological potential of seeds are scarce. Physalis seeds are very small, which may reduce sowing efficiency. A viable alternative to increase efficiency is to use coating polymers by film-coating. In the film-coating process, active material is allocated to the seeds without causing changes in shape and size (Lagoa *et al*., 2012). That process provides greater fluidity and efficiency in sowing, enables distinguishing high value seeds (because of the dyes used), scares off birds, rodents and insects and reduces dust, providing better security for operators and reducing seed injuries caused by herbicides (Avelar *et al*., 2012). However, this coating technology must be adapted to each species due to possible problems regarding germination (Melo *et al*., 2015), e.g., a decrease in water and gas availability as a result of the formation of physical barriers on the tegument. Thus, the goal of this study was to determine the effects of fruit cooling and of seed film coating the germination potential of physalis.

2. Materials and methods

The experimental design was completely randomized in a 2x3 factorial (fruit storage conditions x seed film coating) with five replications and one hundred seeds per plot. Freshly picked physalis fruits that had brownish yellow calyx were used (Rodrigues *et al*., 2012). After calyx extraction, twenty fruits were wrapped in plastic bags and stored for seven days under two conditions: room (average temperature of 25 °C) and cooling conditions (average temperature of 10 °C).

After storage, the seeds were extracted from the fruit through friction in a hand seive, washing under running water and subsequent drying. The hydrophilic polymer coatings Blue AG L-204 DISCO® and Red AG L-203 DISCO® were used to carry out seed film coating, and water was used as witness. A total of 4.5 mL of polymer was diluted into 10 mL of water. The polymer was adhered to the seeds by stirring (Countertop Orbital Shaker, NT 145) in a glass container (100 mL), for 5 minutes at 60 rpm. Then, the seeds were dried on filter paper for 24 hours at 22 °C.

The germination test was carried out in the paper substrate, specifically, between paper. The substrate was moistened with distilled water equivalent to 2.5 times its dry weight. The rolls of paper were kept in a B.O.D incubator at 25 °C, with a 12 hour photoperiod. Evaluations consisted in identifying sprouted seeds (radicle emission) seven, 14 and 21 days after sowing. Results are shown in percentage. The germination rate index was calculated following Maguire (1962).

The F Test was used to determine significance of the treatment effects. The means of the factors "fruit storage conditions" and "coating polymers" were compared using the Tukey test ($p < 0.05$).

There was no interaction among the factors (fruit storage conditions x coating polymers) for any of the evaluated variables (Table 1). Therefore, the variables were analyzed considering the means of each factor.

3. Results and discussion

Fruit storage at different temperatures did not affect the germination viability of physalis (Table 1). Maintaining seeds within the fruit prevents desiccation, and seed longevity depends mainly on the moisture content and storage environmental conditions. Most species exhibit a better conservation of the physiological potential of the seeds in low temperatures. However, *Passiflora setacea* seeds (Pádua *et al.*, 2011) stored at 4 °C temperatures undergo dormancy induction. Therefore, an expansion in studies is recommended to assess the effect of temperature and humidity in physalis seed storage.

In a study to determine physalis harvesting point, Rodrigues *et al*. (2012) found that fruits with brownish yellow calyx have a high content of soluble solids. This characterization was performed with the whole fruit, i.e., considering the epicarp, mesocarp and endocarp with seeds. The seeds represent the largest part of the total fruit weight. Therefore, such phenotypic characteristics related to maximizing germination and the high soluble solids contents make the fruit maturation stage the most appropriate to extract seeds to produce seedlings.

Synthetic polymer coating provided an increase in the percentage and speed of physalis seed germination (Table 1), which occurred possibly because it regulates the soaking speed and reduces the consequent damage. The increased germination performance due to the film coating is also reported for of field crop seeds (soybeans, Marandu grass) (Custódio *et al.*, 2011; Gesch *et al.*, 2012).

Table 1

Germination 7 (7G), 14 (14G) and 21 (21G) days after sowing and germination rate index (GRI) for film coated physalis seed derived from fruits stored under two conditions

Treatments	7G	14G	21G	GRI
Storage (S)				
Room	88.34	88.66	93.00	4.67
Cooling	81.66	88.00	89.00	4.43
F Test	2.22ns	0.04ns	1.12ns	1.37ns
Film coating (Fc)				
Blue AG L-204® DISCO	92.50a	92.50a	93.50ab	4.85a
Red AG L-203® DISCO	90.00a	94.50a	97.00a	4.84a
water	72.50b	78.00b	82.50b	3.97b
F Test	7.91**	9.64**	5.34*	8.31**
F Test (S x Fc)	0.134ns	1.02ns	0.16ns	0.14ns
VC (%)	14.41	10.39	11.37	12.21

Means followed by different letters in the column differ according to the Tukey test; * significant ($p < 0.05$); ** significant ($p < 0.01$); ns – not significant ($p > 0.05$).

In addition, during soaking no disintegration of the coating material was observed. Such disintegration could lead to the formation of a dough without resistance, would limit the passage of oxygen and moisture to the embryo (Sampaio and Sampaio, 2009). This is a positive result once it shows the potential of film coating in enhancing germination conditions, as a finishing technique and for pesticides adherence to seeds.

4. Conclusion

The cold storage of physalis fruit for seven days does not affect seed germination viability. The seed coating increases the germination percentage and speed. This information promotes propagation and consequent production of physalis due to a practical option of conservation of seeds, via maintenance within fruits, and possibility of coating treatments such as potentiation factor of physiological seed viability.

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