SHELF LIFE OF BIOFORTIFIED BAKED CASSAVA CHIPS IN DIFFERENT PACKAGES

DETERMINAÇÃO DA VIDA DE PRATELEIRA EM CHIPS DE MANDIOCA BIOFORTIFICADA

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RESUMO - O objetivo desse estudo foi avaliar a influência da barreira do material da embalagem e da injeção de gás nitrogênio na vida de prateleira de chips assado de mandioca biofortificada. Os chips foram acondicionados em três tipos de materiais flexíveis com e sem injeção de nitrogênio. Durante estocagem a 25ºC/75%UR, verificou-se que o final da vida de prateleira era definido pela perda de 50% dos carotenoides nos chips em embalagens inertizadas de poliéster metalizado/polietileno de baixa densidade e polipropileno biorientado-BOPP metalizado-met/BOPP, respectivamente aos 80 e 30 dias da estocagem e 20 dias em BOPPmet;BOPP sem N_2. No polipropileno sem N_2 a vida de prateleira foi definida em 20 dias por alterações sensoriais e perda de carotenoides.
Palavras-chave: Chips de batata-doce biofortificada; embalagens com injeção de nitrogênio; propriedades de barreira; retenção de carotenoides, vida de prateleira.

ABSTRACT - The aim of this study was to evaluate the influence of packaging material barrier and nitrogen gas flushing packaging in the shelf life of biofortified baked cassava chips. The chips was packed in three flexible packaging material with and without nitrogen injection. During the storage at 25ºC/75%RH, the end of shelf life of chips was defined by 50% loss of carotenoids in packages with nitrogen of the metalized polyester / low density polyethylene and bioriented polypropylene - BOPP metalized - met /BOPP, respectively at 80 and 30 days of storage, and 20 days in BOPPmet/ BOPP without N2. In polypropylene without N_2 the shelf life was set at 20 days by sensory changes and loss of carotenoids.
Keywords: Biofortified baked cassava chips; nitrogen gas package; barrier properties; retention of carotenoids, shelf life**.**

INTRODUCTION

The development of products made of yellow cassava with high level of carotenoids, such as cassava chips, may be an alternative as a food source of vitamin A and it is better accepted among children and adolescents.

METHOD

Product: Baked chips (65°C / 3.5h) of cassava cultivar BRS Jari produced at the Experimental Field of Embrapa Cassava and Fruits, Cruz das Almas, BA – Brazil.

Packages: Table 1 describes four types of packaging studied, all of them with 40g of biofortified baked cassava chips.

Table 1. Main characteristics of the packages evaluated.

Package material	Thickness (µm) total (partial)	WVTR	OTR	Package filling
PETmet/LDPE	68 (14 / 58)	0.93	1.04	With nitrogen
BOPP/metBOPP	44 (24/24)	0.61	39.04	With nitrogen
PP	51	3.97	1,370	Without nitrogen

PET met - metallized polyester; LDPE - low-density polyethylene; BOPP - biaxially oriented polypropylene; PP – polypropylene.

OTR - Oxygen transmission rate (cm^3 (STP).m^{-2}.day^{-1}) at 23°C, 1 atm and dry conditions

WVTR – Water vapor transmission rate (g water.m^{-2}.day^{-1}) at 38°C and 90% RH

During the storage of cassava baked chips at 25ºC/75% relative humidity (RH), the residual oxygen of the headspace in the packaging was quantified using gas chromatograph (Agilent model 7890, conductivity detector) (Lemos et al., 2008).

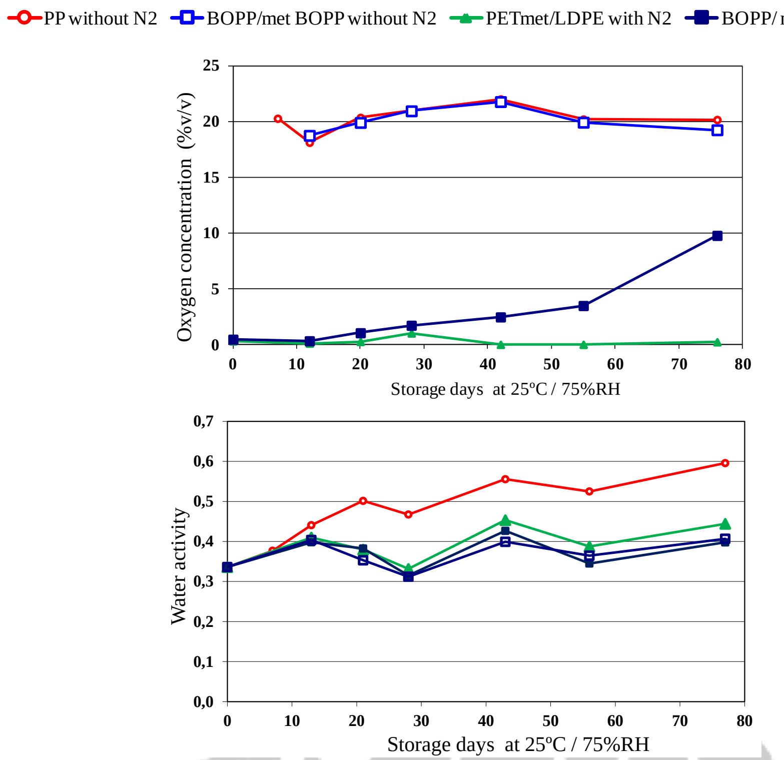
The water activity of the chips was determined by hygrometer based on psychrometric – (Decagon, model Aqualab series 4TEV) at 25±1ºC. The total carotenoids concentration was determined as described by Rodriguez-Amaya (2001), by absorbance at 450nm in spectrophotometer UV-VIS (Shimadzu model UV-1800). The sensory quality of the cassava chips was analyzed using a 9 cm non-structured line, with verbal anchors only at each end, for rancidity flavor (0=absent, 9=extreme), crispness (0=crispy, 9=wilted), and overall quality (0=excellent, 9=very bad) by a team of 13 trained sensory panelists. The limiting of acceptability in terms of sensory was set at rating 4.5 for all attributes analyzed. The data were statistically evaluated using software Minitab 16.1.0.

RESULTS AND DISCUSSION

Headspace oxygen content in packages

During storage at 25ºC/75% RH, in the packages which nitrogen gas flushing (Figure 1a) the oxygen increased over time in the BOPP/metBOPP headspace packages, perhaps due to the consumption of part of the oxygen in oxidation reactions, which could be replaced by permeation through the package material. However, in the PETmet/LDPE packages, the oxygen in the headspace has gradually been reduced because the oxygen consumed in oxidation reactions may not be replaced by permeation through the package material, due to its good oxygen barrier properties of this material as shown at Table 1. In the packages without nitrogen flush, the quantity of oxygen fluctuated around of 21% (atmosphere air composition).

Figure 1. Headspace oxygen content in packages (a) and cassava chips water activity during the storage at 25ºC/75%RH (b).



(a) (b)

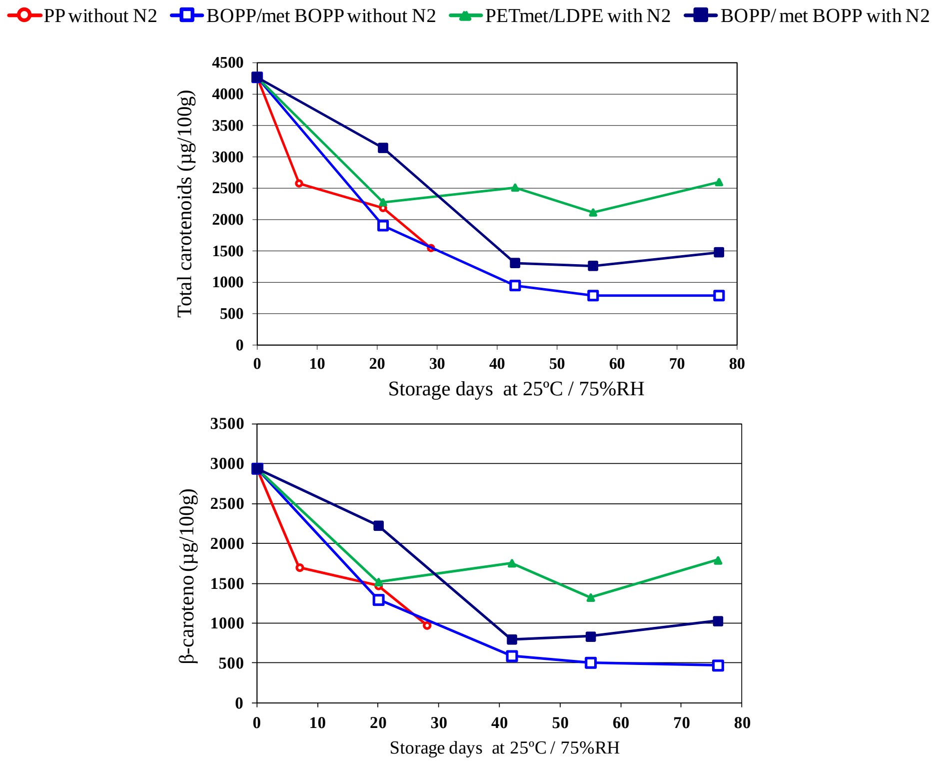
Water activity of baked cassava chips

In the data showed in Figure 1b, it is possible to notice the increase of water activity to 0.45 of the chips packed in PP after 22 days of storage resulting in crispiness loss. In PETmet/LDPE packages the chips present higher water activity than chips in BOPPmet/BOPP after 40 storage days.

Loss of carotenoids in the cassava chips

Losses of 50% total carotenoids and ß-carotene did not occur in PETmet/LDPE until the end of study period due to the lower initial oxygen in the headspace (Figure 2), and in BOPPmet/BOPP nitrogen gas packages after 30 storage days due to the OTR of the packaging material that caused ingress of O_2 during storage (Figure 1a). In packages without nitrogen, a similar reduction of carotenoids occurred in chips of BOPPmet/BOPP and PP after 20 storage days, due to the 21% initial residual oxygen in the headspace, which is as the same as the atmospheric air.

Figure 2. Loss of total carotenoids (a) and β-carotene (b) of cassava chips during the storage.

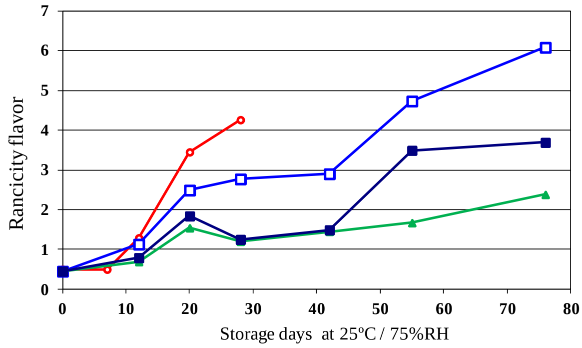


(b) (b)

Rancid flavor of baked cassava chips

The lipids oxidation caused rancidity flavor development (Figure 3) and rejection of chips after the 56th and the 30th storage days, respectively, in BOPPmet/BOPP and PP packages without nitrogen, due to the residual oxygen in the headspace. Estimated rancid flavor development will cause rejection of chips in nitrogen packages of BOPPmet/BOPP after the 90th storage days, and not rancid rejection was observed in PETmet/LDPE until the end of study period due to the lower initial oxygen in the headspace (Figure 3).

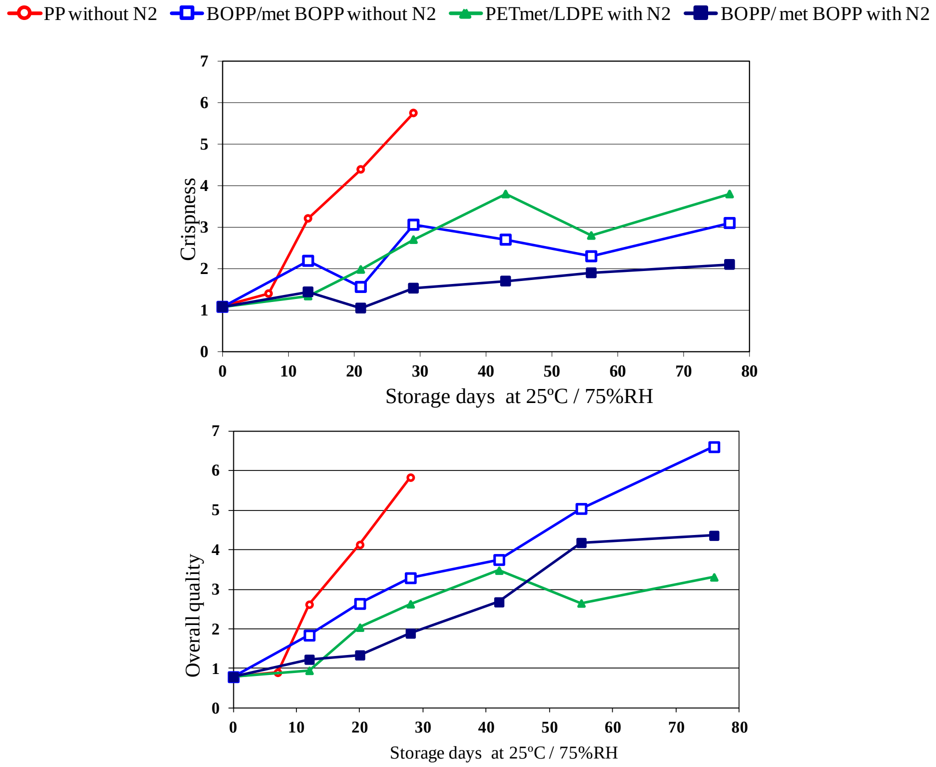
Figure 3. Development of rancidity flavor of cassava chips during storage at 25ºC/75%RH.



Crispness of cassava chips

In packages with nitrogen, chips presented lower crispness in PETmet/LDPE than in BOPPmet/BOPP (Figure 4a) after 43 storage days. In PP without N_2 occurred crispness loss and rejection of chips after 21 days of storage (Figure 4a).

Figure 4. Changes in the crispness (a) and overall quality (b) of cassava chips during the storage.



(a) (b)

Loss of overall quality of cassava chips

No rejections of the chips by loss of overall quality (Figure 4b) occurred in PETmet/LDPE until the end of study period but in BOPPmet/BOPP packages with nitrogen was estimate after the 80th storage days. In packages without nitrogen, the rejections occurred after 49-day storage in BOPPmet/BOPP and after 22-day storage in PP.

CONCLUSION

The shelf life of baked cassava chips was defined by 50% loss of carotenoids in packages with nitrogen in 80 days in PETmet/LDPE and 30 days in BOPPmet/BOPP and in 20 days in BOPPmet/BOPP without nitrogen. In PP without nitrogen, the shelf life was 20 days by loss of half of sensorial characteristics and 50% loss of carotenoids. The use of flexible material with good oxygen barrier as PETmet/LDPE and nitrogen gas flushing was necessary to preserve for higher time the carotenoids of biofortified baked cassava chips.

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