



Quality of Carioca bean seeds under different storage conditions

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Topics

- **Introduction**
- **Material and methods**
- **Results and Discussion**
- **Conclusions**

Introduction

- Bean crops (*Phaseolus vulgaris*) play a social role because it puts many small farmers into food production chain



Poor
technology



bag
handling



High
Technology
mechanized



Bulk
handling



■ Nutritional and Technological Quality

- Dry beans average about 22% protein in the seed, the highest protein content of any seed crop. They contain all essential amino acids, but methionine.
- Beans are an excellent source of fiber, starch, minerals and some vitamins
- Different shape and colours



**CARIOCA
BEANS**

■ Crop Problems

- Farmers produce their own seeds for subsequent crops without structure and technical monitoring during storage
- During beans storage, grain quality is deteriorated, an irreversible and cumulative phenomenon, with its intensity depending on different factors
- Stored grains present a reduction in physiological quality, tendency to browning, especially beans of the *carioca* variety, and also with an increase in hardness and cooking time – factors that can lead to a reduction in consumption

■ Seeds storage



Co-operative stores / Silo

room storage



Small farmers

Hermetic storage –

MODIFIED ATMOSPHERE

COLD STORAGE



Mantém a germinação e o vigor das sementes

Mantém a qualidade física, nutricional e sanitária de grãos armazenados



■ Storage conditions

- High-temperature and relative humidity conditions during storage - defect known as *hard-to-cook* (HTC).
- MODIFIED ATMOSPHERE - there is a decreased oxygen concentration and higher concentrations of nitrogen and carbon dioxide, while preserving grain quality and maintaining germination
- if storage type is not applied properly, it can cause the death of the embryo because of damage to the integrity of the tissue

■ Storage conditions

- COLD STORAGE

- Even if grain moisture is above the ideal level, safe storage is possible when the storage temperature is reduced because the low temperature inhibits metabolism and the growth of microorganisms and insects

- this study aimed to evaluate the physiological quality of bean seeds stored under cooled and modified atmosphere conditions for 120 days.

Material and methods

- Common bean (*Phaseolus vulgaris*) IAPAR-81 - Carioca
- **Cooled storage:** the bean seeds were packed in 500 ml PET bottles and stored at 5°C.
- **Modified atmosphere storage:** the bean seeds were placed in 1 kg glass containers. Oxygen was partially removed by burning
- **Control storage:** the seeds were placed in Kraft paper bags and maintained under room conditions, at 21°C on average.

- Samples were removed from the containers at 0, 30, 60, 90 and 120 days and analyzed for the physiological quality of the seeds.

- **Moisture content**

Measured with a standard oven: 5.00 g were weighed and placed in an oven at 105°C for a period of 24 hours, expressed as a percentage (BRAZIL, 2009).

- **100-seeds weight**

Two sub-samples of 100 seeds were counted manually and then weighed (BRAZIL, 2009).

- **Electrical Conductivity**

Two sub-samples of 50 seeds from each treatment were placed in glasses with 75mL of deionized water and incubated at 25 ° C for 24 hours. The electrical conductivity of the solution was measured, the results were expressed in $\mu\text{Sm.cm}^{-3}$. (Correa and Alfonso Jr., 1999)

■ **Germination test**

A germination test was performed according to the rules for seed analyses (Brazil, 2009), with four replications of 50 seeds per sample. Two countings were performed as the test was carried out: the first one was performed after five days and assessed the number of normal seedlings; the second one was performed after nine days, taking into consideration the number of normal and abnormal seedlings, and the number of dormant and dead seeds. The results were expressed as percentages and transformed into $\arcsin(/100)$.

■ **Statistical Analysis**

The trial was arranged in a split-plot design, having storage conditions as plots (control, refrigeration and modified atmosphere) and storage time as sub-plots (0, 30, 60, 90 and 120 days). The results were subjected to analysis of variance (ANOVA) and mean comparison (Tukey's test), with the 5% level of significance. Statistical analysis was performed using the SISVAR 5.0 software (FERREIRA, 2006).

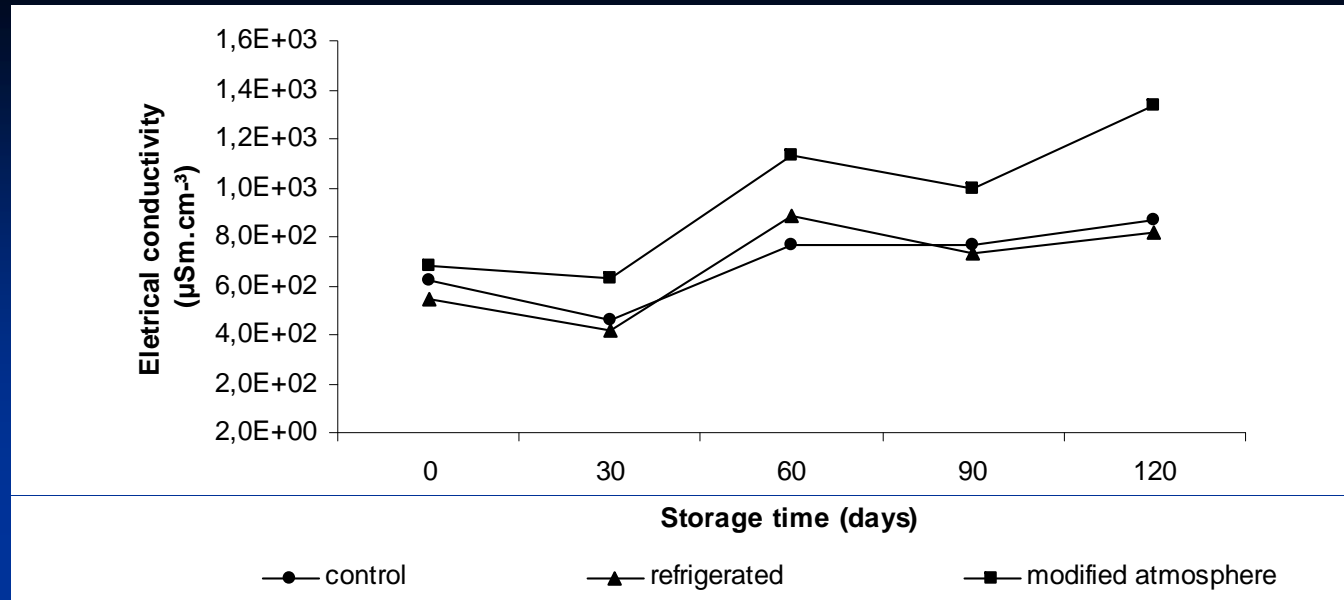
Results and Discussion

Summary of analysis of variance for tests of moisture content, 100-seed weight and electrical conductivity and for germination tests of bean seeds stored under ambient, refrigerated and modified atmosphere conditions over time

V.F.	D.F.	Mean Squares and Significances					
		Moisture Content	100-seed weight	Electrical Conductivity	Normal	Abnormal	Dead
Type of storage	2	7.4091**	1.2752ns	5.889×10^5 **	0.2960**	0.0293*	0.0215 ns
Residual - storage	12	0.9642	0.3137ns	1.849×10^4	0.0164	0.0068	0.0063
Time	4	1.8025ns	0.4516ns	6.816×10^5 **	0.0101ns	0.0231ns	0.0104 ns
Type of storage*Time	8	2.4890*	0.3093ns	4.426×10^4 ns	0.0291**	0.0097ns	0.0085 ns
Residual - Time	48	0.8913	0.1706ns	2.132×10^4	0.0112	0.0100	0.0056
Coefficient of variation of plot	-	12.296%	3.035%	17.482%	10.65 %	35.92 %	37.89 %
Coefficient of variation of sub-plot	-	6.345%	2.248%	18.464%	8.81 %	43.60 %	35.77 %

ns: non-significant by the F -test * Significant at 5% probability level by the F-test** Significant at 1% probability by the F-test

- Variations in moisture content were observed to occur in the seeds during the storage period under room conditions. In cooled and modified atmosphere treatments, there were no significant differences in moisture content during 120 days of storage. For the seeds stored at room temperature, moisture content ranged from 10.12% to 13.48%.



- Seeds stored in modified atmosphere had higher electrical conductivity. However, this increase occurred for the three storage conditions along storage time.

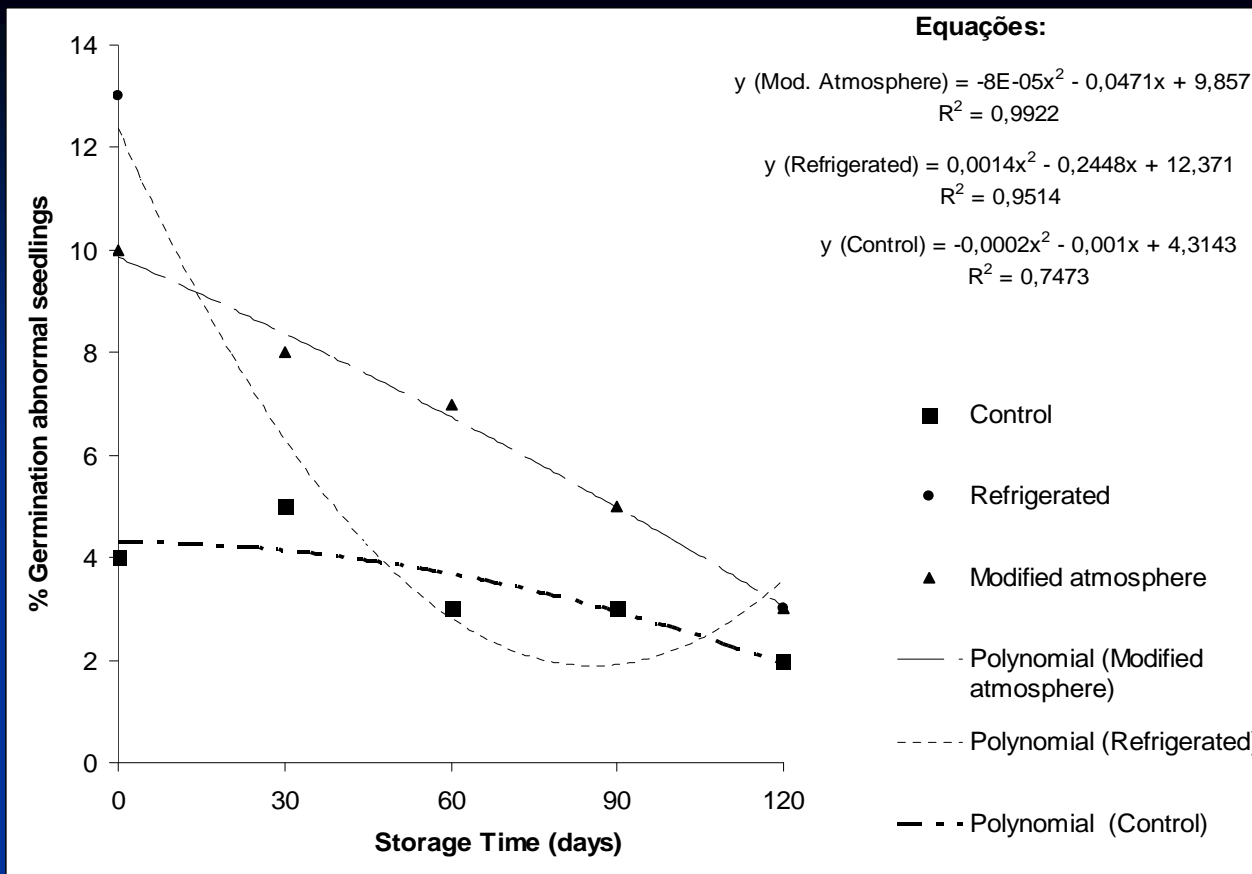
Mean values of normal seedlings (%) of bean seeds stored under ambient, refrigerated and modified atmosphere conditions overtime.

#

Storage	Storage time					Mean
	0	30	60	90	120	
Control	92 aA	92 aA	90 aA	92 aA	92 aA	92
Refrigerated	80 bA	90 aA	91 aA	92 aA	92 aA	89
Modified atmosphere	86 bB	72 bB	69 bA	83 aAB	72 bAB	76
Mean	86	85	83	89	85	

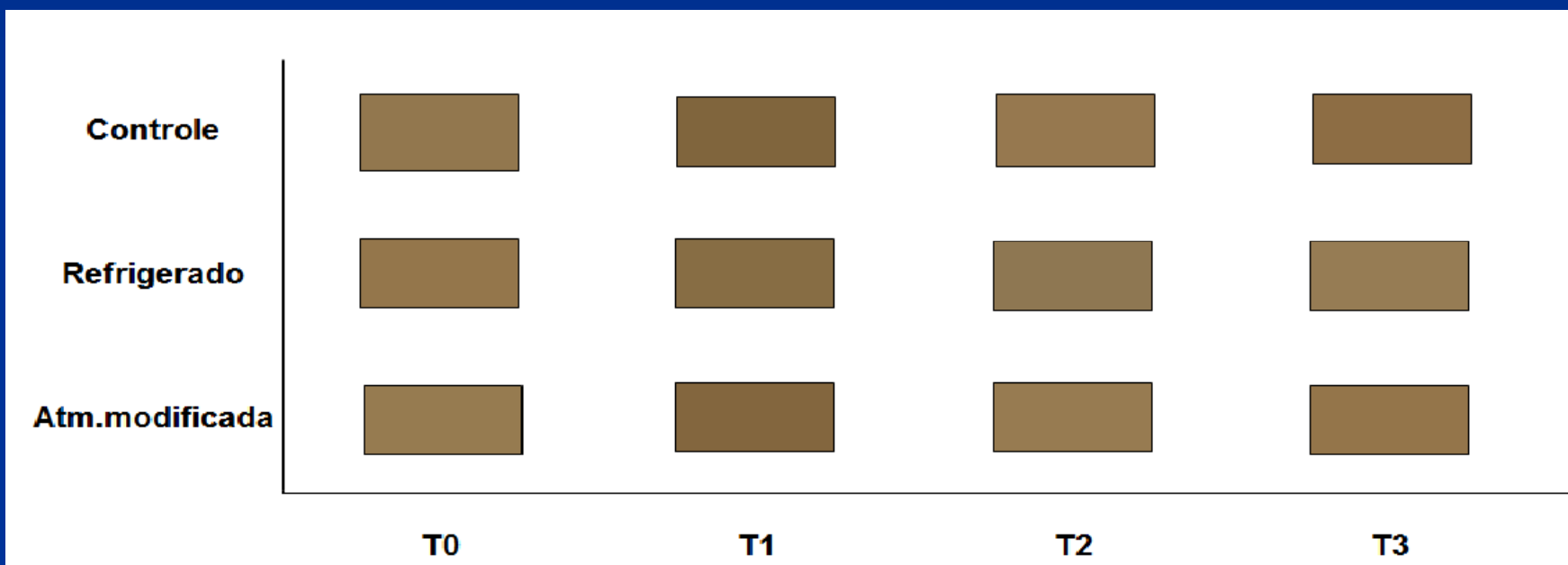
Means followed by the same lowercase letter in the column and capital letter on the row do not differ by the Tukey's test at the 5% level of significance.

- Standard - 80% State Commission of Seeds and Seedlings - RS (2000).
- Modified atmosphere - below



- Percentage of seedlings that did not germinate (dead seedlings): there were no statistical differences
- Modified atmosphere with low oxygen concentration showed higher values for this quality parameter.

Other results (color)



- Tendency to browning in beans of the *carioca* variety - storage and modified atmosphere



Conclusions

- Modified atmosphere condition with low oxygen concentration led to a decrease in the physiological quality of bean seeds during storage when compared to the control and cooled conditions.

Thanks!!!!

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