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# Evaluation of Shelf-life of potatoes stored in two different packaging February 2021

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# Aim of the trial:

comparing the effects of two different packaging (net bag vs paper bag) on potatoes stored 12 days at 20°C .

plastic net bag



paper bag



# Materials and methods

Potatoes (cv “Constance”; cat I, cal 45/75, L 22/02/2021) were packed in two different types of bags from Ortofrutticola Parma on 22/02/2021 (T0). Bags of potatoes were stored in a refrigerated room at 4-6°C until the next day (23/02/2021) and delivered at Astra laboratory in the afternoon.

12 bags of potatoes for each type were kept on the counter of the laboratory at 20°C and exposed at artificial light during the morning. The sampling started after two days from packaging (T2) on 24/02/2021.

## Plastic net bags

(16x57x12,5cm):

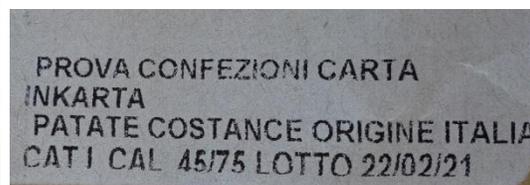
**medium weight 2036 g**  
**containing 7 -12 potatoes**  
**(about 9).**



## Paper bags

(16x57x12,5cm)

**medium weight 1551 g**  
**containing 5 -11**  
**potatoes (about 7).**



# Quality parameters evaluation

Quality parameters were evaluated every two days until the last storage day (12 days) through the opening of one net and paper bag at T2, T4, T7, T9, T11 (5 bags).

Six bags were opened only in last sampling day (T14).

Sensory analysis were carried out at the end of the trial (T14) on potatoes not affected by greening process.

		Quality parameters evaluated:
T2	24/02/2021	✓ bags integrity
T4	26/02/2021	✓ condensation inside the bags
T7	01/03/2021	✓ washability: external appearance of potatoes after washing. Visual evaluation taking account the main superficial alterations due to mechanical, physiological or parasitic phenomena (CNIPT scale).
T9	03/03/2021	✓ freshness evaluation using a scale ranging between 0 (not fresh) and 10 (very fresh).
T11	05/03/2021	✓ sprouting (presence/absence, length and color of the shoots).
T14	08/03/2021	✓ greenness of the peel (presence/absence and percentage of extension)
		✓ scabies (presence/absence and percentage of extension)
		✓ rots (presence/absence and percentage of extension)
		✓ peel and pulp color directly below the peel using a Minolta colorimeter (CIE L*a*b*)

Results on shelf-life of potatoes stored in two different packaging at 20°C.

# Quality at T2: 24th February

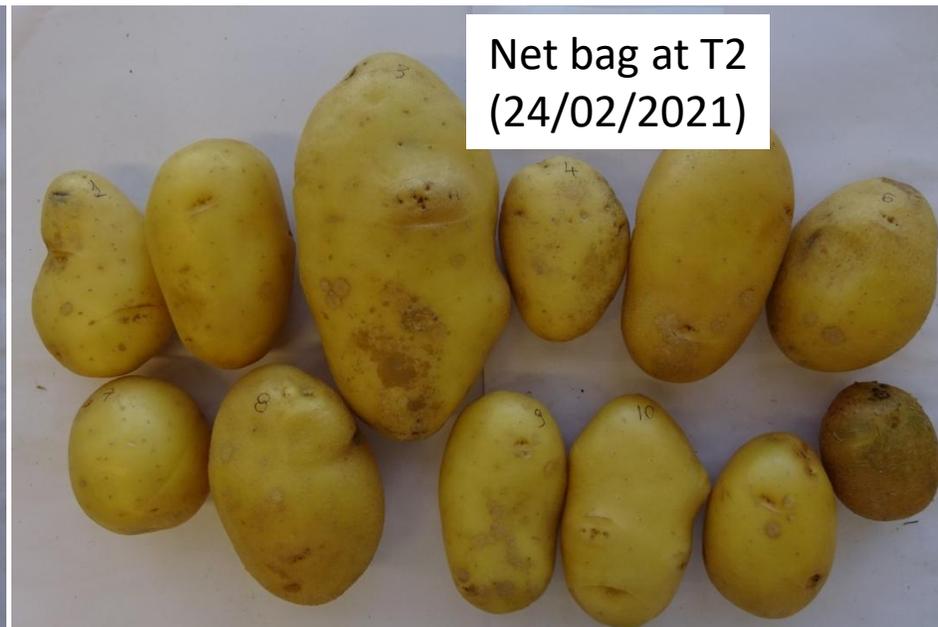
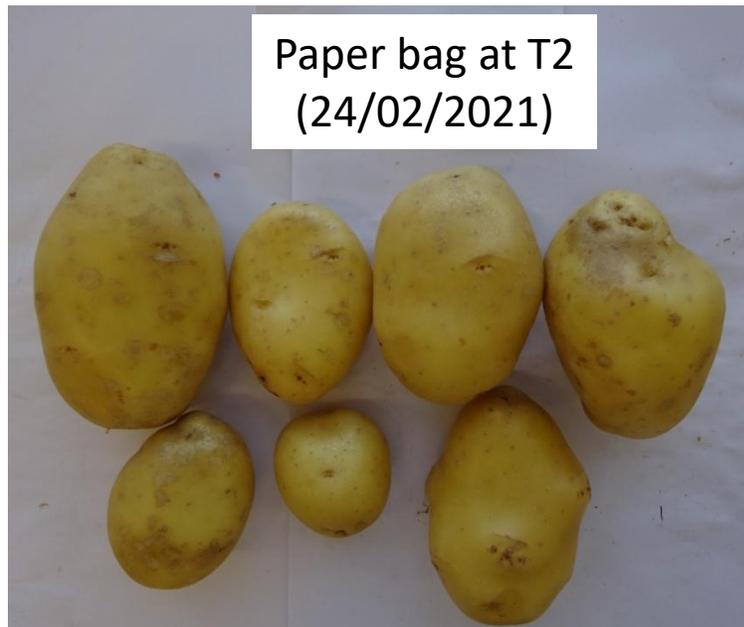
Tubers in both types of packs were very variable in the shape and size.

## Paper bag:

- Scabies (*Helminthosporium solani*) is on the surface of all tubers (7 potatoes) with an extension of 11%.
- No greenness and no sprouting.
- Washability score: 5,5.
- Freshness score: 9,0.

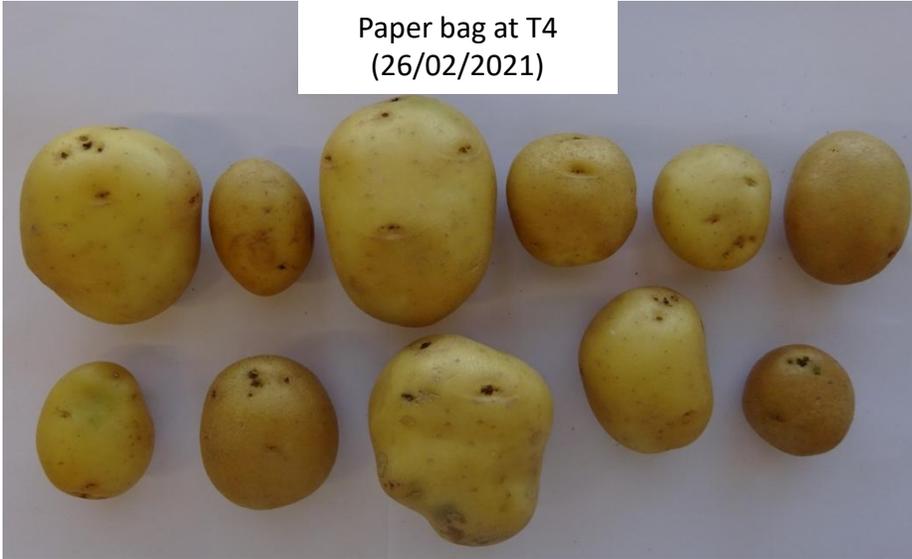
## Net bag:

- Scabies (*Helminthosporium solani* and *Actinomyces scabies*) is on the surface of all tubers (12 potatoes) with an extension of 6,5%.
- 1 tuber shows a suberified peel.
- 1 tuber shows mechanical damage.
- 3 potatoes are slightly green.
- 1 tuber is bruised.
- Washability score: 5,0.
- Freshness score: 6,5.



# Quality at T4: 26th February

Paper bag at T4  
(26/02/2021)



- 3 tubers have small greenness areas counting about 1% of the total surface.
- 1 tuber has sprouts (1 mm long).
- Freshness score: 8,5.



Net bag at T4  
(26/02/2021)

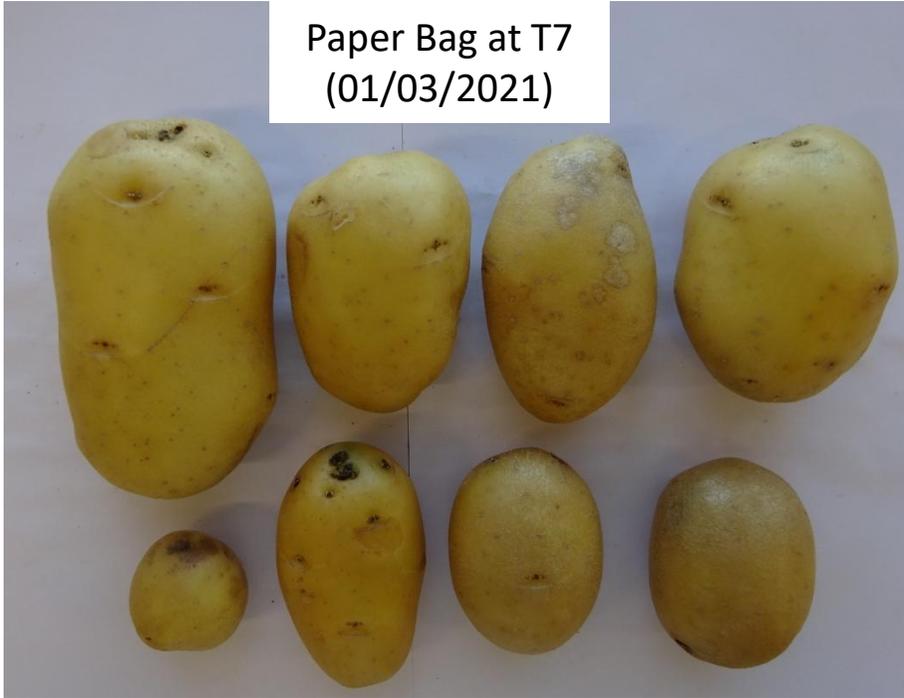


- 2 tubers have small greenness areas counting about 6% of the total surface.
- No sprouting.
- Freshness score: 7,0.



# Quality at T7: 1st March

Paper Bag at T7  
(01/03/2021)



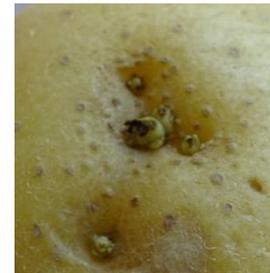
- 3 tubers have green areas counting about 0,9% of the total surface.
- 3 potatoes show sprouts (0,5 - 2mm long).
- Potatoes show a slight wilting.
- Freshness score: 6.



Net bag at T7  
(01/03/2021)

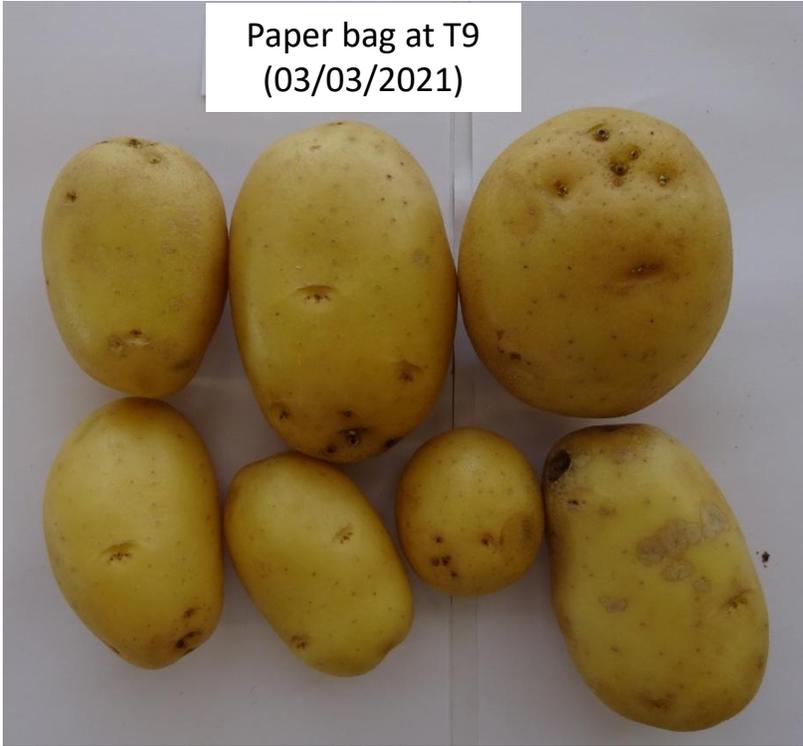


- 5 tubers have green areas counting about 2,8% of the total surface.
- 7 tubers show green sprouts (0,5-1,5 mm long)
- 3 potatoes are bruised.
- Potatoes show a slight wilting.
- Freshness score: 6.



# Quality at T9: 3rd March

Paper bag at T9  
(03/03/2021)

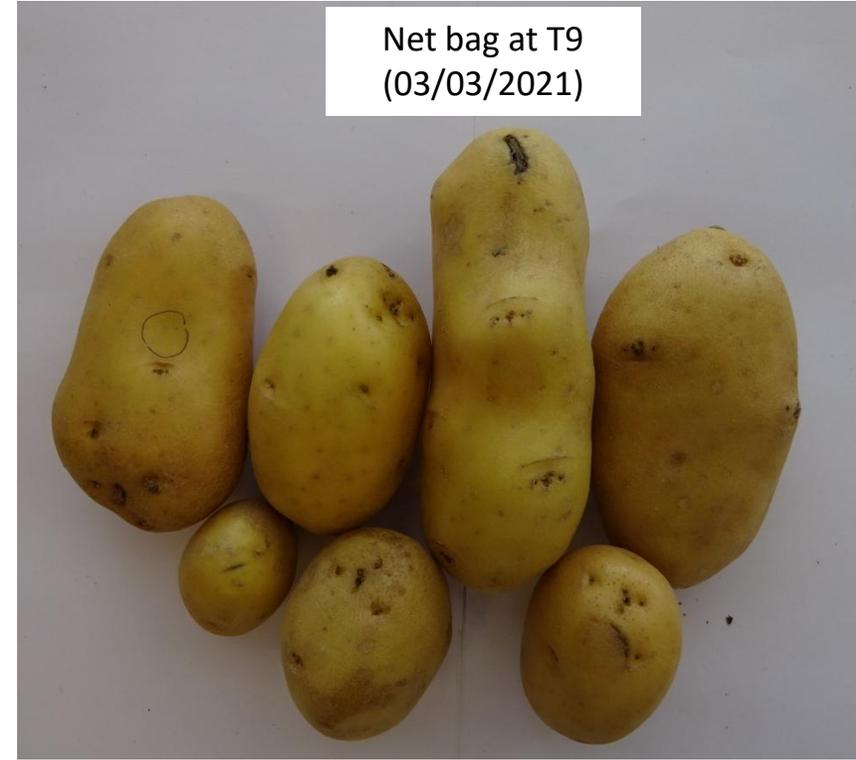


At T9, potatoes stored in paper bag appear slightly more fresh than potatoes in the net bag (freshness score: 6,5 and 6).

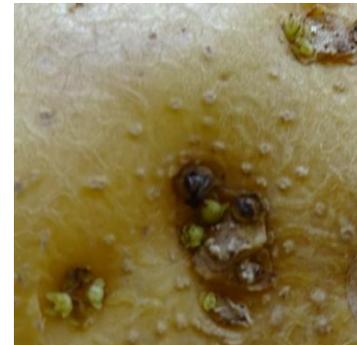
Tubers stored in net bag lost the typical peel color showing a trend to be slightly green

- 5 tubers show sprouts (0,5 - 2 mm long).

Net bag at T9  
(03/03/2021)



- 5 potatoes have small sprouts (0,5 - 1,5 mm long).  
- 5 potatoes show greening on about 18,6% of the total surface.



# Quality at T11: 5th March

Paper bag at T11  
(05/03/2021)



- 4 tubers with sprouts (until 1,5 mm long)
- 2 tubers are green. Greening affects about 3,7% of the total surface of sample.



At T11, freshness of both packed potatoes doesn't change comparing with that of T9, (paper bag score: 6,5, net bag score: 6)

Net bag at T11  
(05/03/2021)



- Sprouts on 6 potatoes (until 5 mm long)
- 4 potatoes are green for a total green surface of 5,7 %.

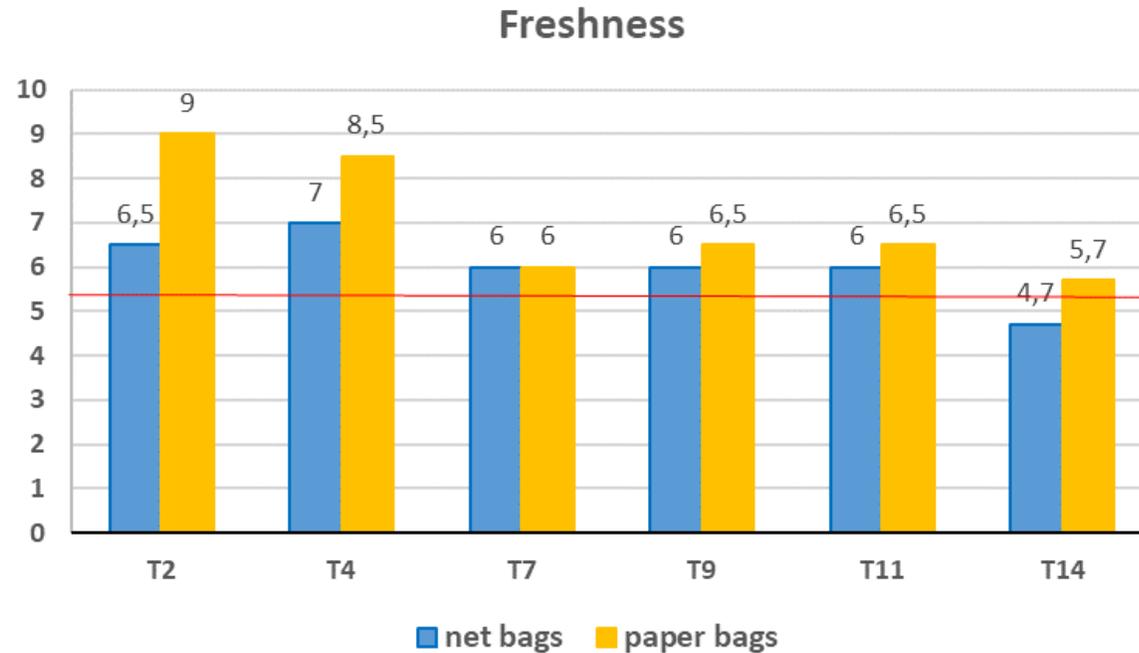


# Quality at T14: 8th March



Paper stored potatoes were much less green and showed a more intense yellow color on the peel than potatoes stored in net bags. Samples are slightly dehydrated (freshness score: 5,7; acceptable), but less than those stored in net bags (freshness score: 4,7; not acceptable). Sprouting does not depend on packaging, but paper bag stored potatoes show less green and shorter sprout than net bag stored potatoes.

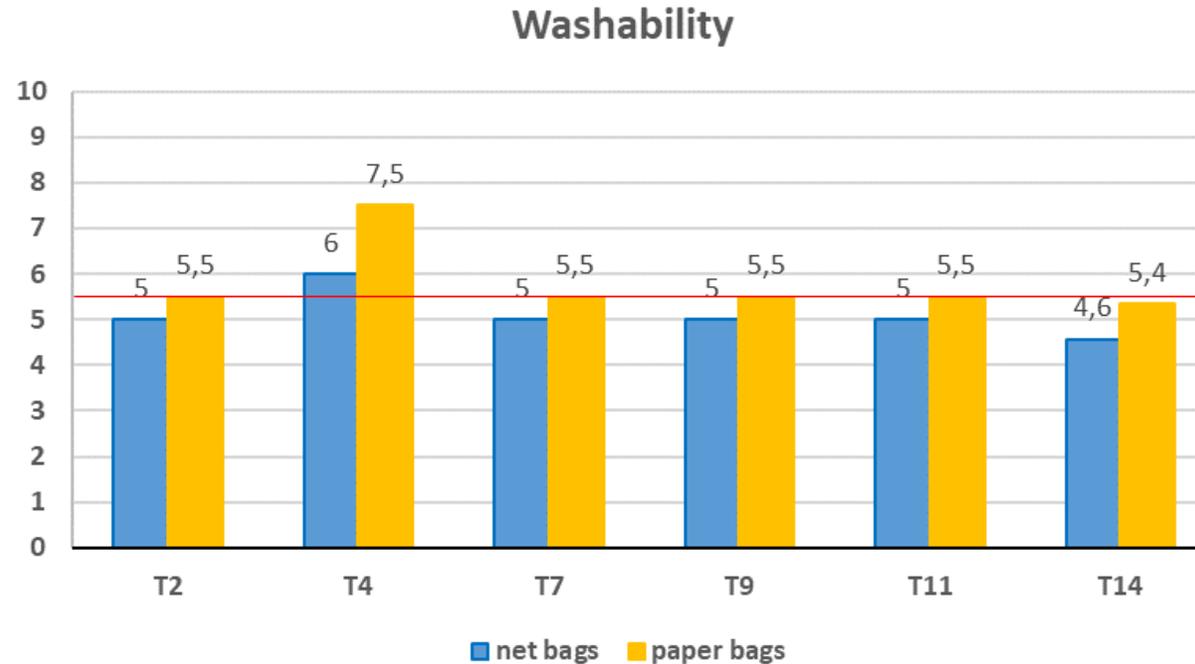
# Freshness (scores)during storage



NOTE: red line corresponds to the value 5,5 (insufficiency)

Freshness decreases over time. At T2 and T4, freshness of paper stored potatoes is higher (respectively scores: 9 and 8,5) than the ones stored in net bags (respectively scores: 6,5 and 7). Potatoes in the paper bags are slightly fresher than those in the net bags from T9 to T14. At T14, the tubers in the net bags are not acceptable (score 4,7) and tubers stored in paper bags are fairly acceptable (score 5,7).

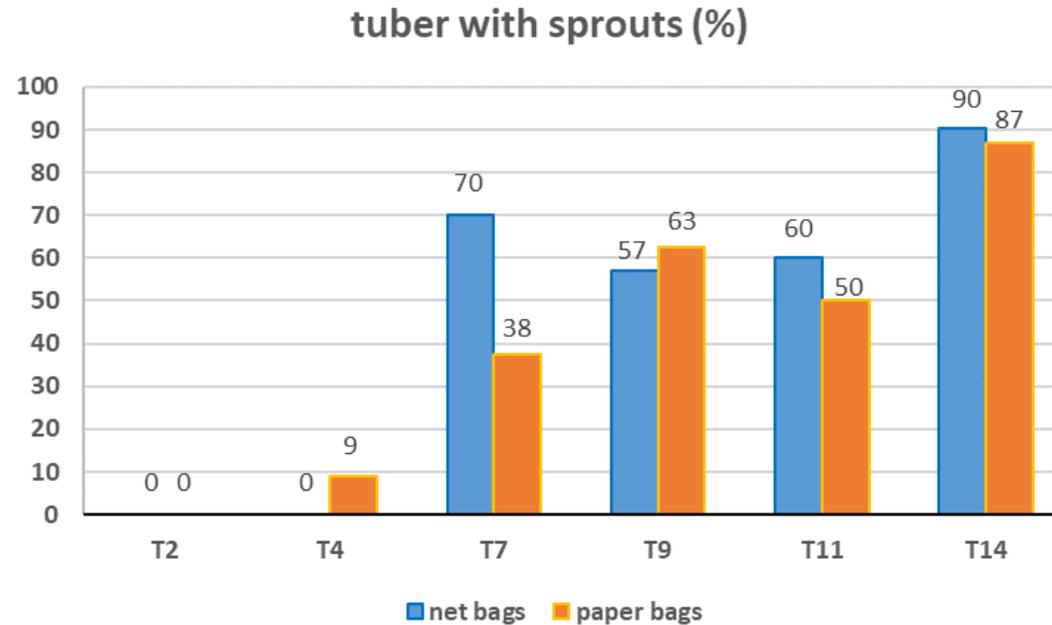
# Washability (scores) during storage



NOTE: red line corresponds to the value 5,5 (insufficiency)

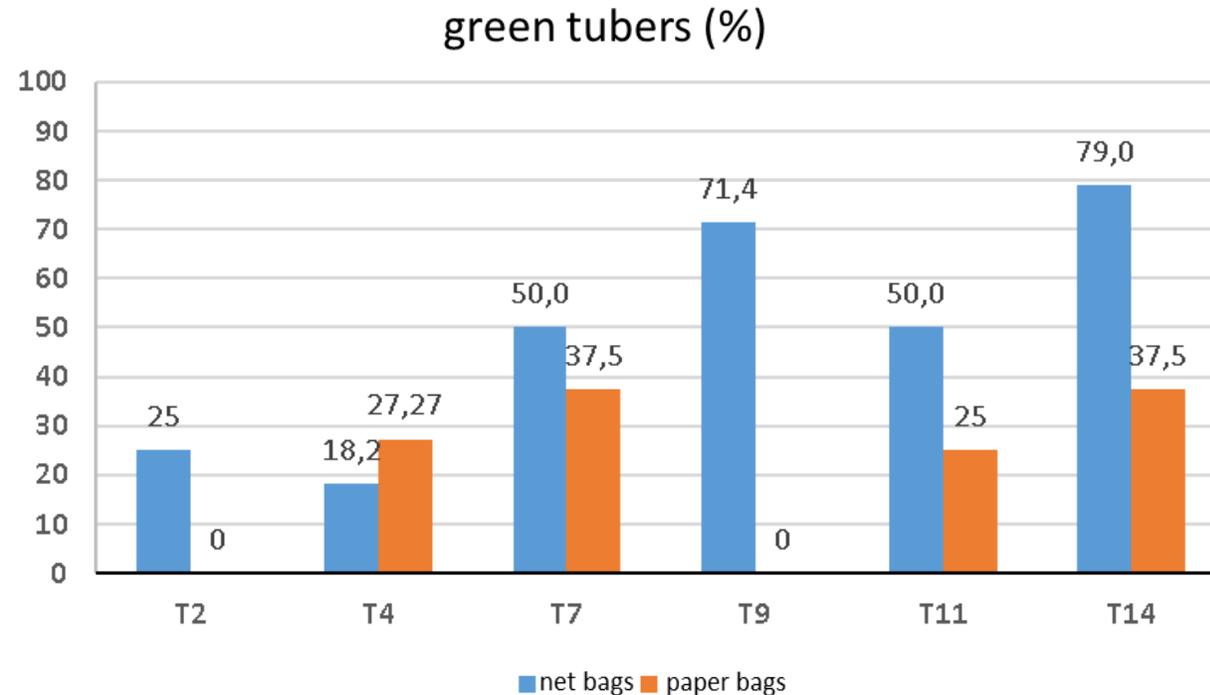
The judgment is strongly influenced by the presence of scabies (*Helminthosporium solani* and *Actinomyces scabies*) on the surface of potatoes starting from T2. Paper stored potatoes has been scored 5,5 (limit of acceptability), while samples stored in net bags has been scored 5,0 (not acceptable). To be noted that number of potatoes was a bit different in the paper and net packs: about 7 tubers (1,5 Kg) in paper bags, about 9 tubers (2,0 KG) in net bags.

# Tubers with sprouts (%) during storage



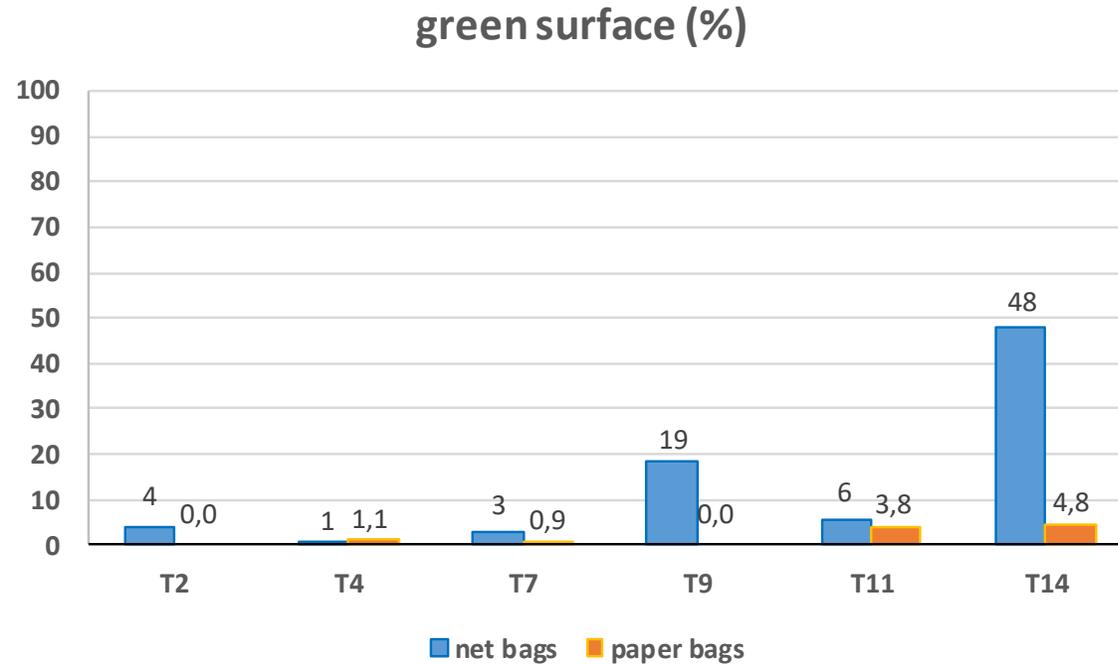
Sprouts appear in paper stored potatoes starting from T4 (9% of tubers). At T7, sprouting is very high in potatoes stored in net bags (70% of the tubers against 38% of paper stored potatoes). Starting from T9, sprouts are green in potatoes packed in net bags. In the last sampling day (T14), the percentages are similar : 90% of potatoes in net bags and 87% of potatoes in paper bags.

# Green tubers (%) during storage



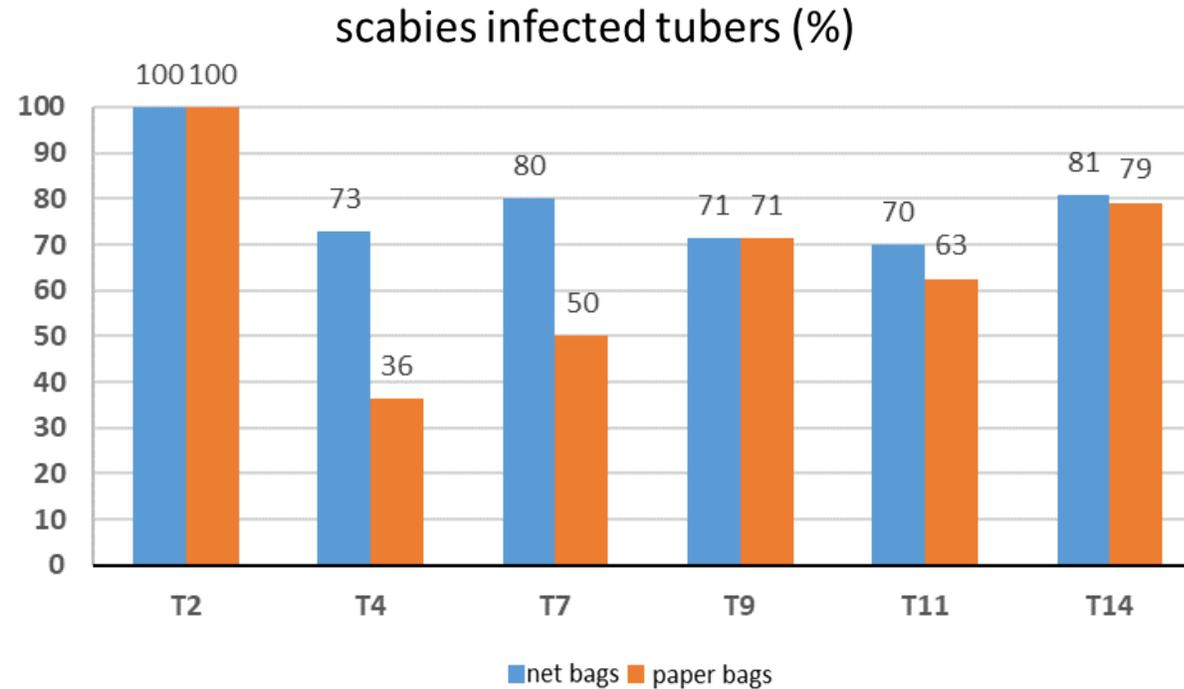
Potatoes stored in net bags show green areas starting from the first sampling day (T2), the amount of green tubers increases over time more than that of samples stored in paper bags: 50% of tubers in net bags is green at T7; 79% of tubers in net bags and 37,5% of paper stored potatoes are green at T14.

# Amount of green surface (%) during storage



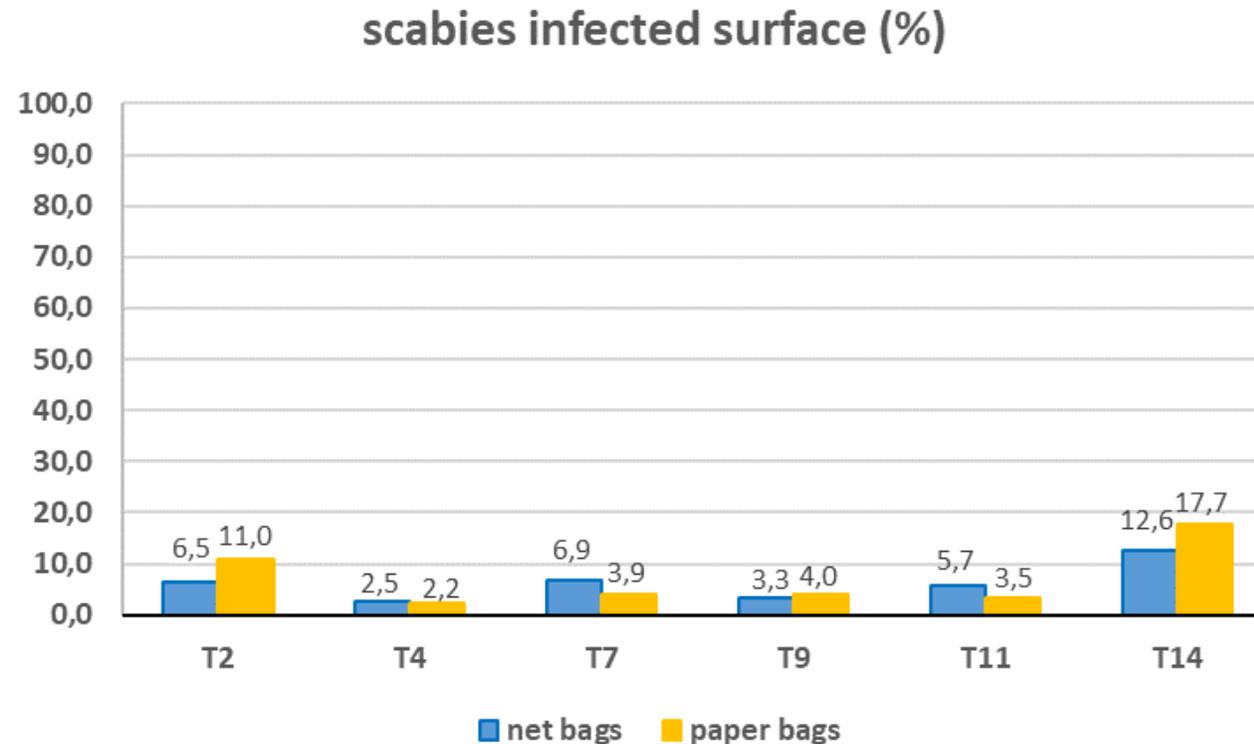
The percentage of green surface increases starting from T7, the increase is higher in samples stored in net bags than the ones in paper bags. At the end of storage (T14), the percentage of green surface was 48% in samples in net bags. Samples stored in paper had 3,8% of green areas at T11, 4,8% in the last storage day (T14). Therefore, the percentage of green areas in potatoes stored in net bags is ten time higher than that of potatoes stored in paper bags.

# Scabies infected tubers (%)



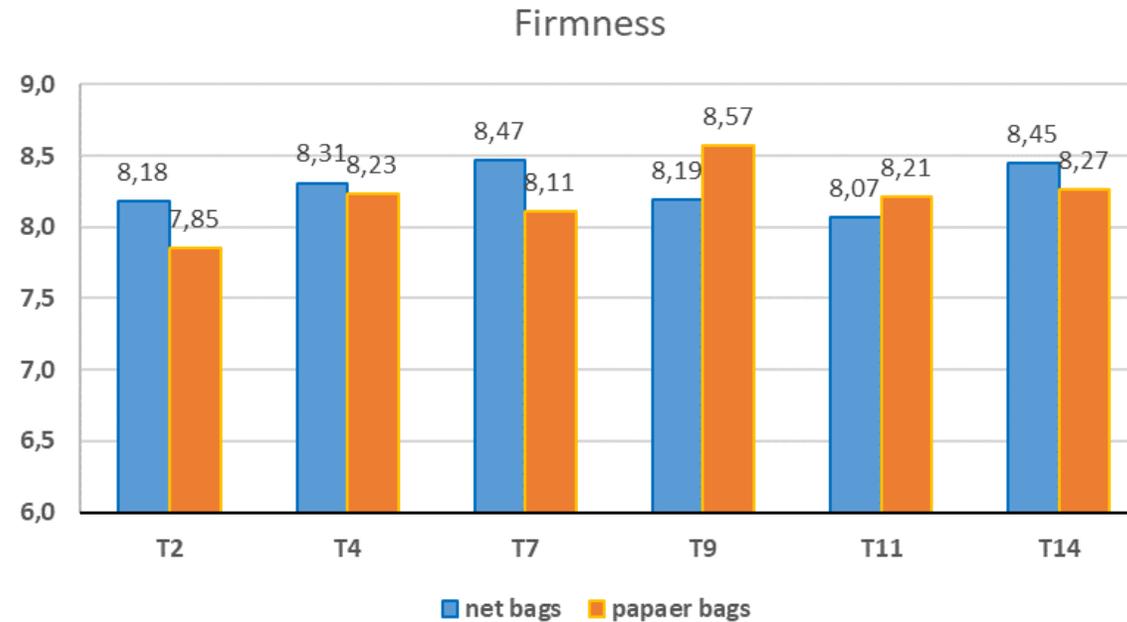
Scabies was already present on the tubers during the packaging phase. In particular, 100% of the tubers in both types of packages show infection by scabies at T2. During the storage, the infection was more casual with a trend to be lower in the paper stored tubers until T7. Percentage of both samples are similar starting from T9 until T14.

# Scabies infected surface (%)



The amount of infected surface (%) does not depend on packaging, changes are related to the initial infection rate of packed potatoes.

# Firmness (Kg)



There are no significant differences in the firmness of potatoes depending on the type of packaging. The graph shows a trend to increase mainly in paper stored potatoes over time.

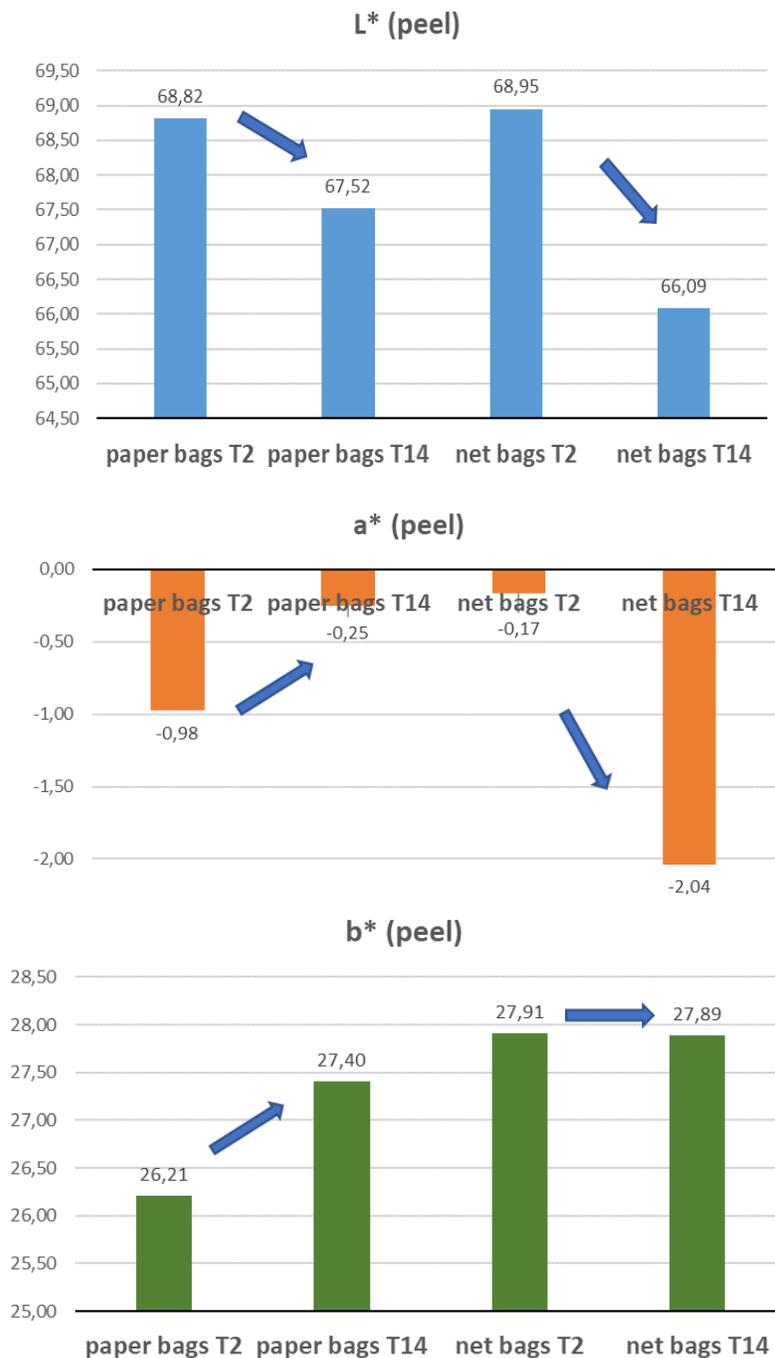
# Variation of the peel color indices (L\*a\*b\*) during storage

The **L\*** and **b\*** parameters of color slightly vary over time compared to fresh packaged potatoes (T2):

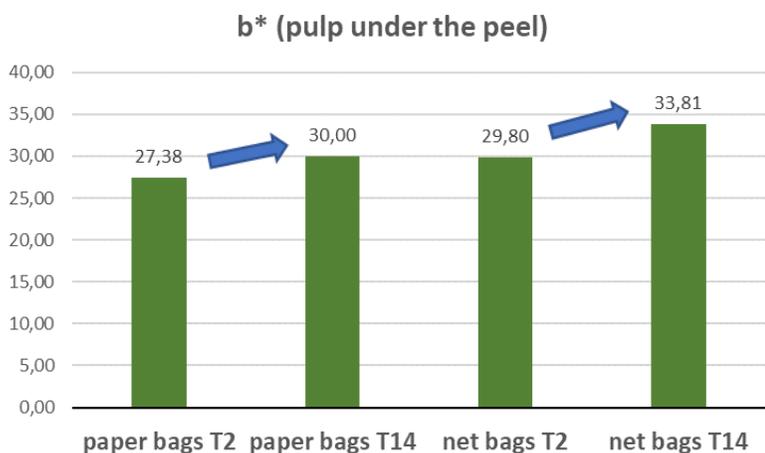
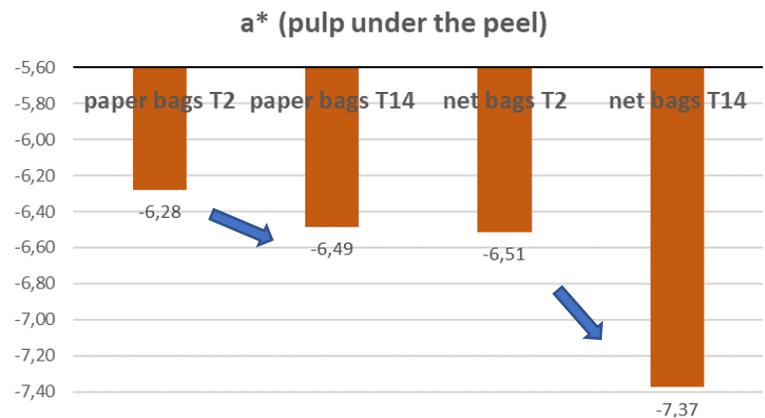
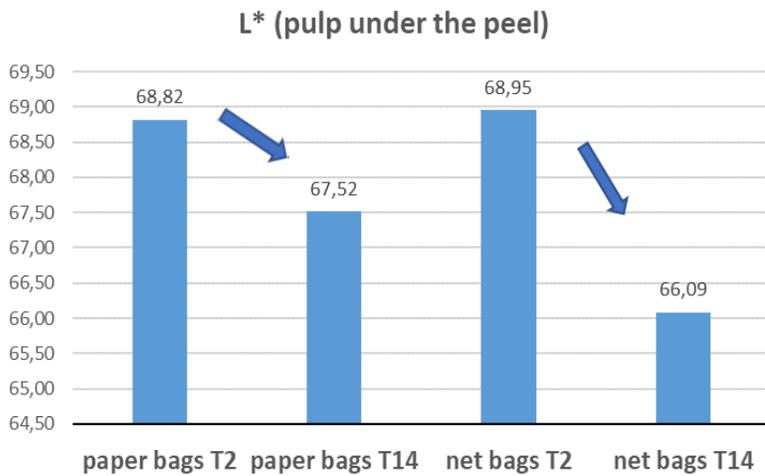
- At T14, **L\*** (lightness) value is decreased more in potatoes stored in net bags than that in samples stored in paper bags, indeed potatoes are slightly dark.

- **a\*** (green) value becomes less negative (from -0.98 to -0.25) in paper stored potatoes, quite the opposite, it becomes more negative in potatoes stored in the net (from -0.17 to -2.04). This result indicates an increase visible of 12% in the green.

- **b\*** index (yellow) slightly increases over time in paper stored tubers, while it does not change in potatoes stored in the net bags.



# Color indices (L\*a\*b\*) variation of pulp below the peel during storage



**L\*** (lightness) value, measured in the pulp, tend to decrease in the same way of the value of the peel. The decrease is more evident in potatoes stored in net bags.

**a\*** (green) index has moved towards more negative values in both, paper and net stored samples. The variation is minimal in paper stored potatoes (from -6.29 to -6.49) comparing with that of potatoes in net bags (from -6.51 to -7.37).

**b\*** (yellow) index has become slightly more positive over time in both packed samples. These data indicate that there is a trend to increase of the yellow component of color.



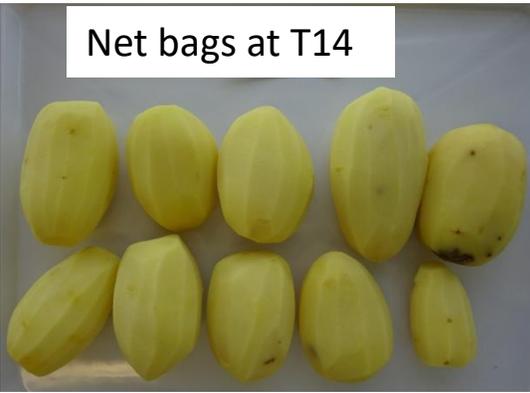
Paper bags at T14



Cooked potatoes



Net bags at T14

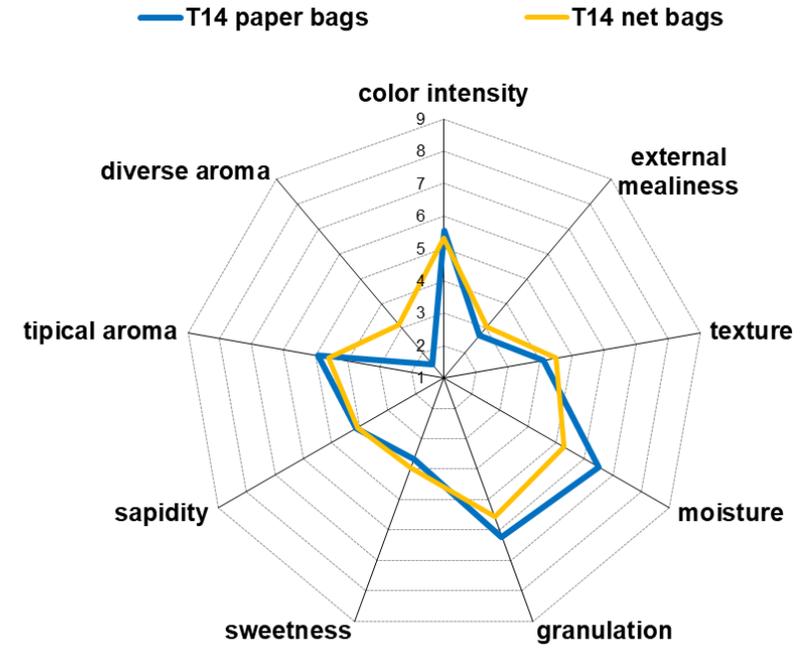


Net bags at T14



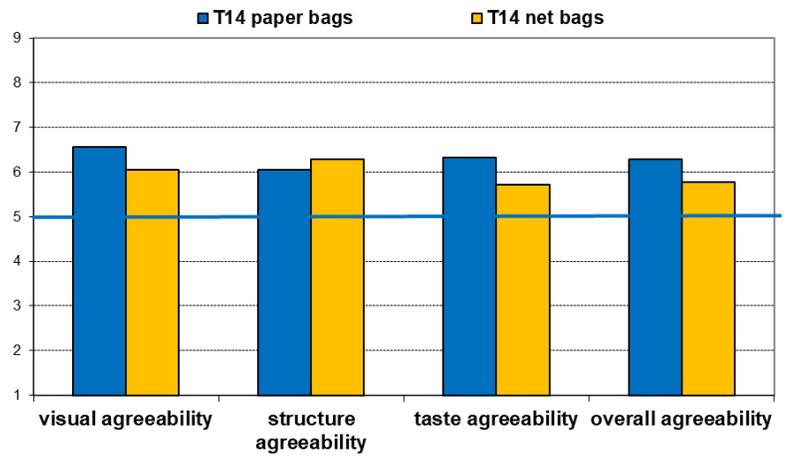
Paper bags at T14

# Sensory profile at T14



Comparison of sensory profiles at T14 revealed a slight perception of chestnut and herbaceous aroma in potatoes stored in the net bags. The granulation was slightly more rough in tubers stored in the net than those in paper bags, while the paper stored tubers were slightly more humid. The judgments of agreeability indicate that visual appearance and taste are more appreciate in paper stored tubers. The judgments about structure of the pulp are very similar. The overall judgment indicate that paper stored potatoes has been scored 6.3 (more than adequate), while net bags stored potatoes received a score of 5.8 (acceptable).

## agreeability comparison



# Conclusions

Freshness has been best preserved in potatoes stored in paper bags: potatoes were still acceptable after 14 days from the packaging, while tubers in the net bags has been evaluated not acceptable.

Sprouting appeared in paper stored potatoes starting from T4 (9%) and in potatoes stored in net starting from T7 (70% of tubers), 38% of potatoes in paper bags had sprouts in the same day. Sprouts appear green on potatoes stored in net bags from T9. At T14, the amount of potatoes with scabies (%) is similar for both packs: 90% net bags and 87% paper bags.

Greening of peel is also more contained in tubers stored in paper. The green surface is more extended and widespread (even if light and almost imperceptible by eyes) in tubers stored on the net from T9. Differences become more evident and visible at the end of storage (T14) and were also detected through the objective analysis of color parameters. The L\*a\*b\* evaluation confirmed the presence of greener shades on the peel of the potatoes stored in the net bags.

The tubers showed some difference in the sensory profile and acceptability at the end of storage (14 days from packaging): potatoes stored in paper bags had an overall acceptability score of 6.3 (more than adequate), score of potatoes in net bags was 5.8 (acceptable). The major differences were found in the aroma: secondary aromas, such as herbaceous and chestnut, were described in the potatoes stored in the net bags, while the aroma was more typical and without interference in potatoes stored in paper bags.