Plasma Surface Treatment for Enhancing Liquid Retention in Plastic Meat Packaging

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Introduction

Management of meat exudate is still problematic to the fresh food packaging. It facilitates the microbial growth leading to the deterioration of meat quality and safety, and limits the meat shelf life. Most of the plastic meat trays found in markets are difficult to recycle and sent to landfill. A sustainable packaging solution has been developed by using plasma technology to make 100% recyclable plastic meat tray with improved liquid isolation capacities. The liquid retention capacity of liquid-holding recesses (integrated with plastic meat tray) was tested before and after localised plasma treatment.

Figure 1: Meat exudate in plastic packaging tray.

Methods

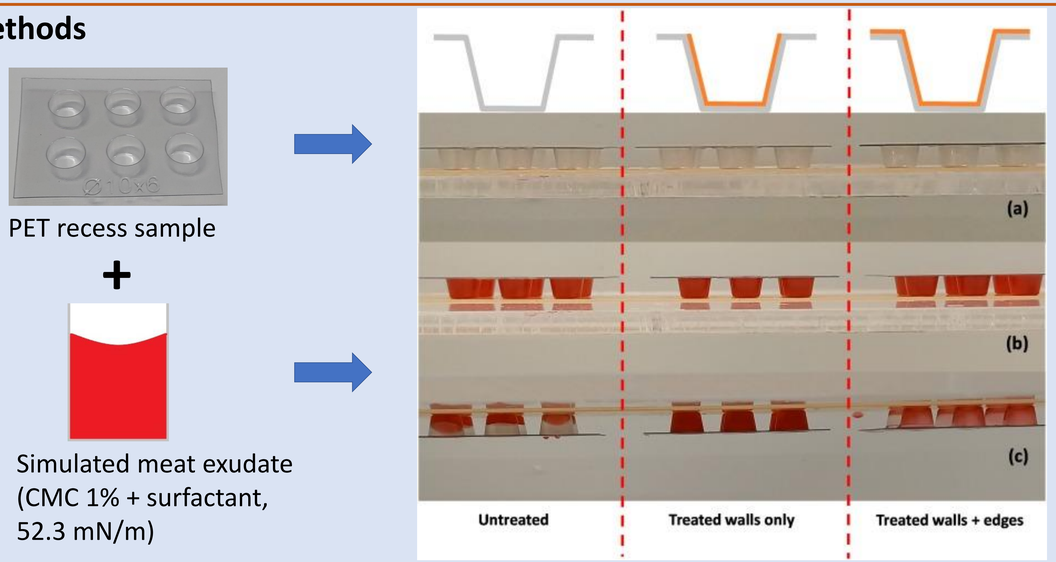

Figure 2: Retention test of PET recess samples with CMC 1% (52.3mN/m); (a) empty recesses, (b) before tilting, (c) after tilting [1].

Results and Discussion

The liquid is trapped in PET recesses due to the geometrical valving functionality. The recess openings act as geometrical valves, inducing liquid pinning as shown in Figure 3. The selective increase in wettability of recess walls by localised plasma treatment results in wetting variations between the recesses and substrate, inducing wetting-based valving functionality that improve their liquid pinning and menisci stability, hence increased liquid retention (~ 2.24 times) than untreated samples as illustrated in Figure 4. This is equivalent to 2972 mL/m^2 for recesses (diameter: 9 mm) with comparable performance of the traditional peach pad (~3000 mL/m^2). The effect of plasma treatment on the improved liquid retention lasted for more than 60 days. However, the treated substrate & recess walls showed almost complete loss in the recess liquid retention [1,2].

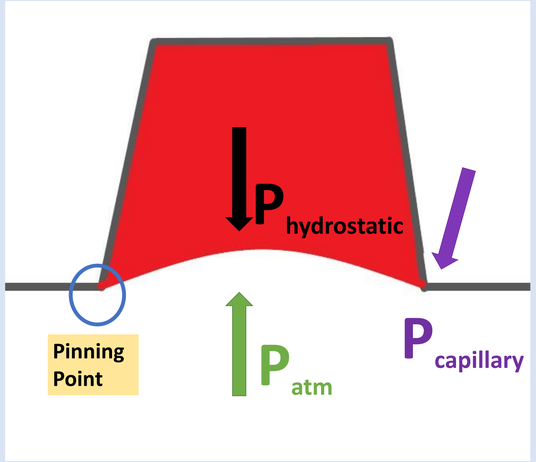

Figure 3: Governing pressures on liquid inside recess cavity.

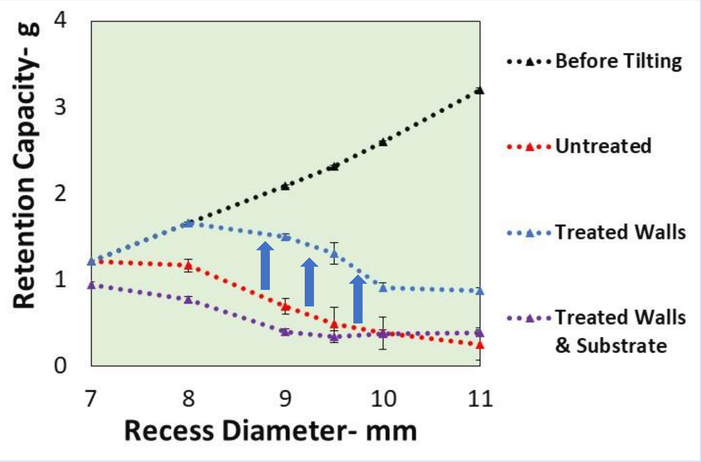

Figure 4: Liquid retention capacity of recess samples based on the application of plasma treatment.

Conclusions

The increased liquid retention of recesses after localised plasma treatment is an effective means to manufacture 100% recyclable plastic tray capable to isolate meat exudates. This can cut millions of non-recycling plastic waste and avoid use of absorbent meat pads.

References

[1] Alaizoki, A., Phillips, C., Parker, D., Hardwick, C., Griffiths, C., Deganello, D., 2021. Effect of plasma treatment on improving liquid retention capacity of capillary recesses for food packaging applications. Food Packag. Shelf Life 30, 100759. https://doi.org/10.1016/j.fpsl.2021.100759

[2] Extrand, C.W., 2017. Spontaneous Draining of Liquids from Vertically Oriented Tubes. Langmuir 33, 12903–12907. https://doi.org/10.1021/acs.langmuir.7b03247