Elimination of *Salmonella* cross-contamination on eggs using antimicrobial coating

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State of the Art

Gastro-intestinal infections caused by *Salmonella* strains, together with *Campylobacter*, are among the most common food-borne diseases in Italy (EFSA journal 2016). Therefore, it is important to avoid the spreading of bacterial colonization on different type of foods. A common vector of *Salmonella* are eggs, which can be contaminated by the laying hen (vertical or horizontal infection) or by contact with contaminated eggs of food (cross-contamination). At the moment, the Italian prevention practices to control *Salmonella* spreading are bacterial controls on laying hens and their environment and eggs brushing before packaging. Other countries allow eggs washing, but this process decreases the shelf-life of the product. This study investigates the efficiency of an antimicrobial coating to avoid *Salmonella* cross-contamination on eggs.

Materials and Methods

First category medium eggs were bought from a local store.

1) A gel containing pectin and alginate as polymers was used to create a coating with or without Lauroyl-Ethyl-Arginate (LAE) as antimicrobial agent. Eggs were coated by dipping technique, dried and stored at 4° C. Uncoated eggs were used as control. The mesophilic aerobic charge was measured during 42 days of storage (sampling days 1, 7, 14, 21, 28, 35, 42). Eggs were washed in saline buffer and proper dilutions were plated on BHIA and SS agar.

2) Challenge Test: eggs were contaminated with *Salmonella enteriditis* by dipping them in a solution containing 1*10^7 cfu/mL bacteria. Afterwards, they were coated as previously described. On day 1, 3, and 7 eggs were rolled onto 15 mm Petri dishes containing a selective medium for *Salmonella*, to evaluate the bacterial charge on the surface.

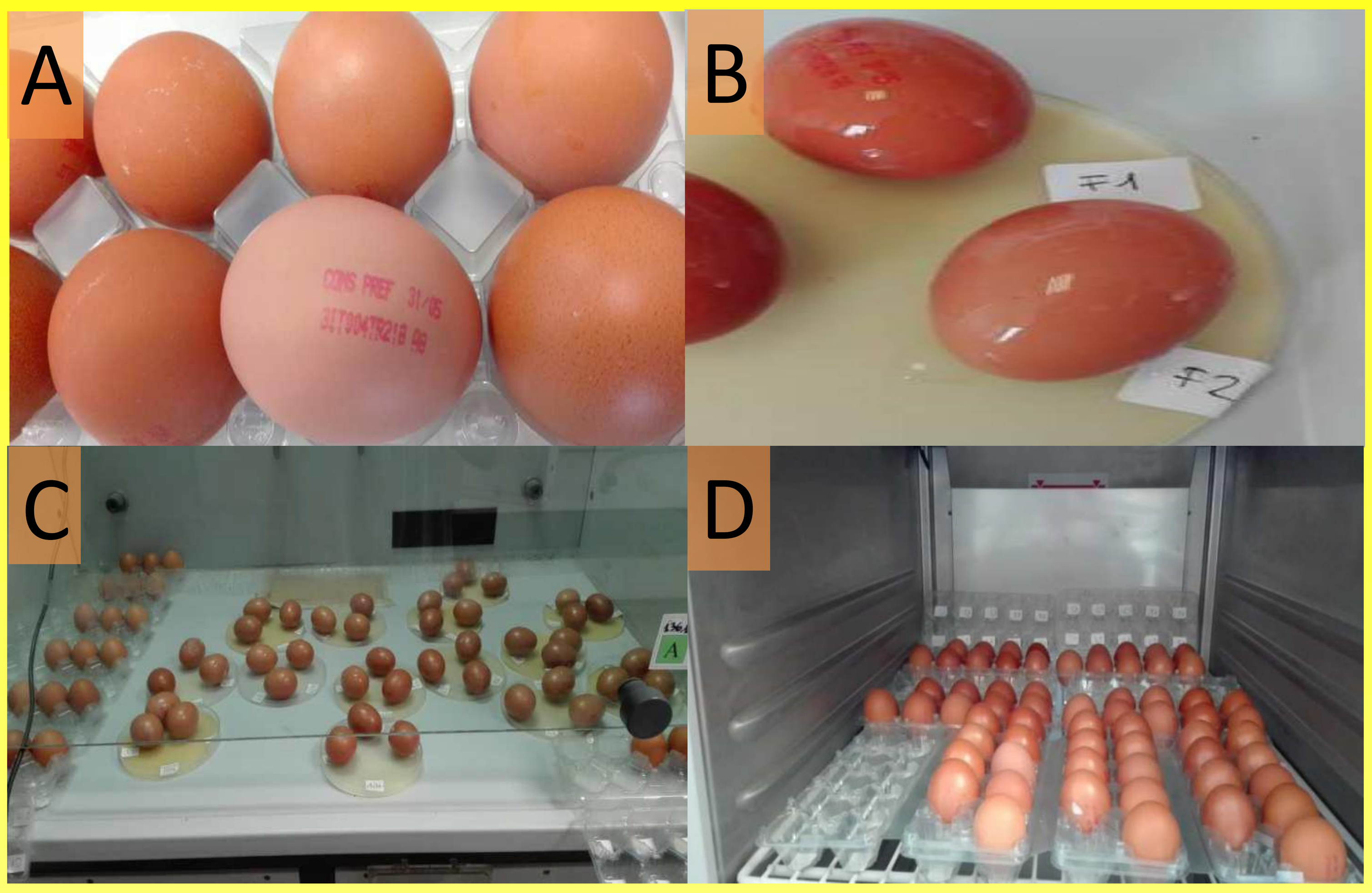

Fig.1: **(A)** fresh eggs, **(B)** coating application, **(C)** drying process, **(D)** storage.

Results

Bacterial charge obtained by plate counting showed both coatings significantly reduced the initial charge and hindered bacterial development (Fig. 2). In particular, the charge of LAE samples remained stable during the whole test. No *Salmonella* colonies were detected. In the Challenge Test, *Salmonella* surface contamination decreased during the storage period. Non-coated eggs started with 849 cfu per egg, reducing to 132 and 120 after 3 and 7 days, respectively. Coated eggs showed a bacterial load almost 2 orders of magnitude lower than control. On day 1, 11 cfu were found on coated eggs and 10 cfu were found on coated+LAE eggs; after 3 days they decreased to 9 and 1, respectively, and no colonies were found on day 7 (Fig. 4).

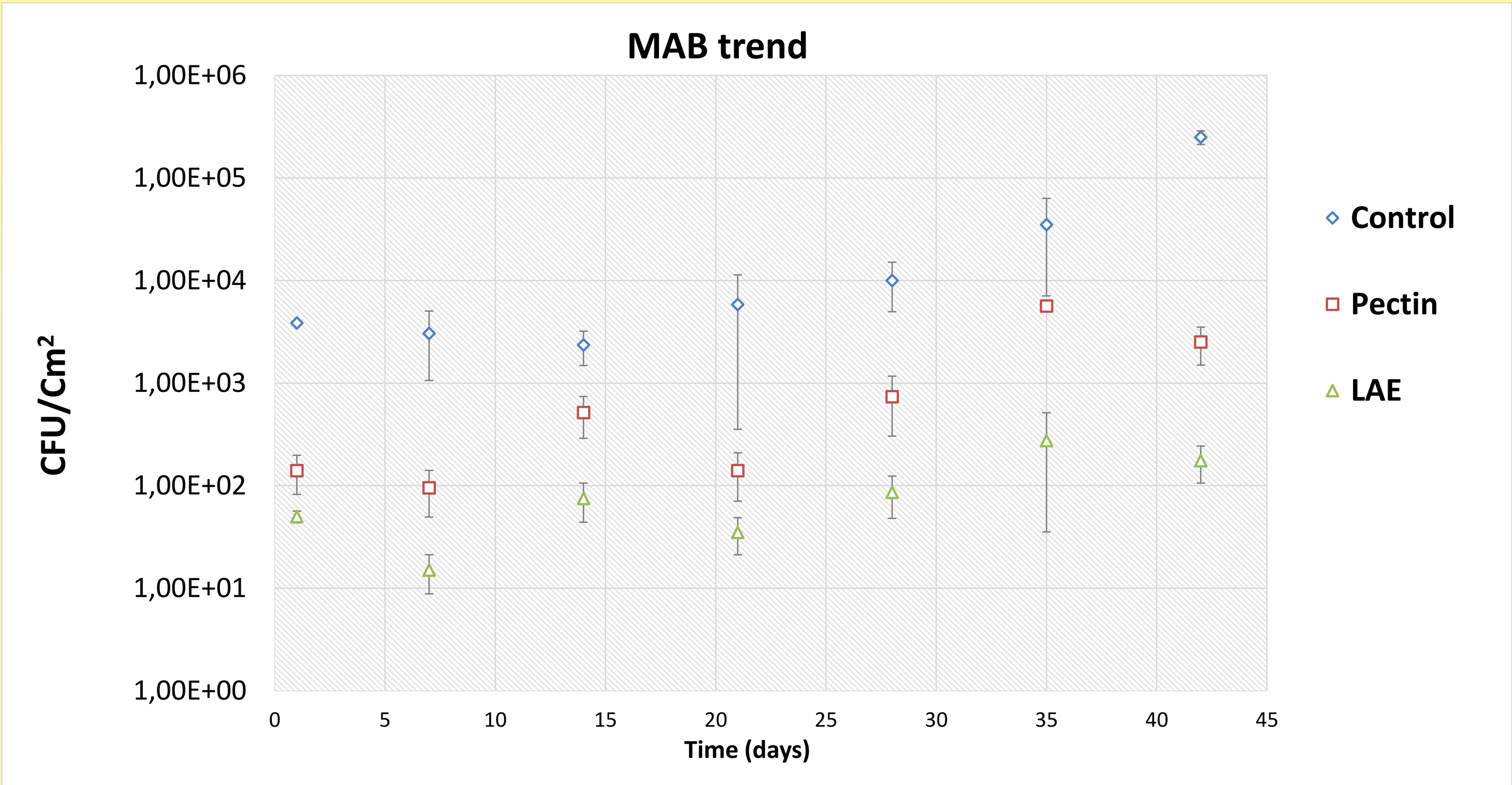

Fig.2: Bacterial trend on egg shells during 42 days of storage.

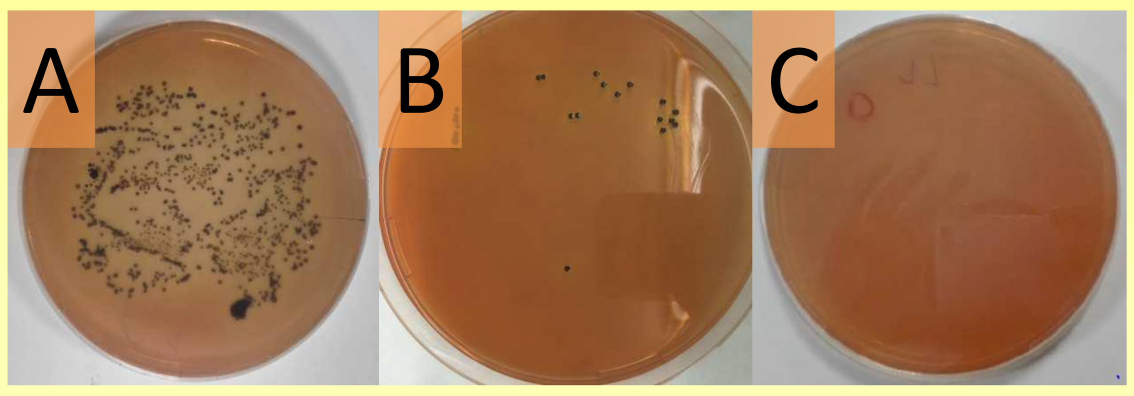

Fig.3: Cross contamination test:
(A) control, **(B)** coated, **(C)** coated+ antimicrobial.

	CFU/EGG		
	CONTROL	COATED	COATED + LAE
DAY 1	849	11	10
DAY 3	132	9	1
DAY 7	120	0	0

Fig.4: *Salmonella* counts per egg.

Conclusions

Coating the eggs with a pectin-alginate polymer drastically improves their food safety and reduces the recovery of *Salmonella* colonies from the egg surface. Therefore, the occurrence of cross-contamination would be highly reduced as well. The positive effect of the coating itself showed to be highly effective even without the addition of antibacterial agents such as LAE. This active packaging could guarantee higher safety for eggs and opens the possibility to test this procedure on other food matrices common carriers of potentially pathogenic bacteria.

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