Antimicrobial Potential of a Clean Label Intervention in Fresh Chicken patties

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Abstract – In this study the potential of a clean label intervention in fresh chicken patties was investigated. Aerobic Plate Counts (APC), Lactic acid bacteria (LAB), *Enterobacteriaceae* and *Salmonella*, as well as physical/chemical changes (water activity and pH) and sensory changes were monitored as a function of treatment and storage time. Chicken patties packed under modified atmosphere (ratio 30% CO_2 & 70% N_2) stored at 4°C, were taken as a control sample. Addition of a blend of Vinegar and Jasmin tea extract was able to extend the shelf life for APC and LAB counts. For *Enterobacteriaceae* and Salmonella a complete control in outgrowth was observed.

Key Words – Ground fresh chicken, Shelf life extension, *Salmonella*, Vinegar, Jasmin tea extract,

I. INTRODUCTION

Poultry meat is a very popular food commodity around the world due to its relatively low cost compared to other meat proteins, its low fat content, high nutritional value and distinct flavour (Barbut, 2002; Patsias, Badeka, Savvaidis, & Kontominas, 2008). Consumption of processed chicken products has also dramatically increased over the last decades (Bianchi, Ferioli, Petracci, Caboni, & Cavani, 2009). Shelf life is an extremely important factor in the fresh meat and poultry industry. In addition to the natural vulnerability to microbial spoilage of the meat, enhancement techniques such as injecting solutions or grinding can also further increase the chances of contamination and lower shelf life. Spoilage of fresh meat and poultry can be affected by a range of bacteria including e.g. Lactic acid bacteria and *Enterobacteriaceae*. Consumers want lean, tasty and tender meat and poultry products, with stable colour and minimal additives. These products must also be convenient to use, good value for money and above all safe and healthy with easily recognizable labels. The objective of this research was to evaluate the antimicrobial efficacy of a clean label intervention as well as assess the effect on taste.

II. MATERIALS AND METHODS

PREPARATION AND TREATMENT OF FRESH CHICKEN PATTIES

Fresh chicken filet was purchased from a local slaughter house (1 day after slaughter). Filet was checked on bones and pre-ground with a diameter of 8mm. Ground poultry meat was homogenized and divided into the test batches. Ingredients were added and mixed in with a Hobart mixer. A second grind was done with a diameter of 3mm before 90 gram patties were made. Two patties were packed together in a gas barrier packaging and packed under modified atmosphere (ratio 30% CO_2 & 70% N_2). All batches were stored under 4°C incubation over shelf life. The model formulation (control patties) consisted of chicken breast (92.59% w/w), water (6.81%), sodium chloride (0.40%), sodium triphosphate (0.20%). The model formulation was modified and corrected on water content to produce the clean label formulation: intervention of Vinegar & Jasmin tea extract (0.7% Verdad® Avanta™ F100, Corbion/Purac, Gorinchem).

MEASUREMENT OF CHEMICAL AND PHYSICAL CHARACTERISTICS

The water activity of the fresh chicken patties was determined using an Aw Sprint TH 500 (Novasina, Talstrasse, Switzerland) by placing approximately 5g portions of chopped meat into a plastic sample cup and inserting into the vapor chamber. The pH of the fresh chicken patties was determined using a flat membrane electrode (744 pH, Metrohm, Herisau, Switzerland). Three random places in the pattie were used for pH measurements for each batch.

MEASUREMENTOFMICROBIOLOGICAL CHARACTERISTICS

A. Microbiological analyses

At regular time intervals, duplicate samples of each batch were taken for microbiological analyses. From each batch a quantity of approximately 20-30 gram was aseptically taken with a spoon and transferred in a stomacher bag. A sterile diluent (0.85% w/w sodium chloride and 0.1% w/v bacteriological peptone (Oxoid) was added in a ratio of 1:3 (meat: diluent) and homogenized for 60 sec (Stomacher 400

Lab Blender, Seward Medical, London, England). Additional dilutions were made in the same sterile diluent. A 50 µl portion of the appropriate dilution for each sample was plated with a spiral plater (Eddyjet type 1.23, IUL Instruments, Barcelona, Spain) on different media. Samples were tested for Aerobic plate counts (TSA, Oxoid); Lactic acid bacteria (MRS, Oxoid); *Enterobacteriaceae* (VRBS, Oxoid). Plates were incubated for APC under aerobic conditions at 37°C for 24 hours; Lactic acid bacteria under microaerophilic conditions at 30°C for 48 hours; *Enterobacteriaceae* under aerobic conditions at 37°C for 24 hours.

B. Inoculation *Salmonella*

Samples were inoculated with a two strain *Salmonella* cocktail (*Salmonella* enterica & *Salmonella* Typhimurium). The strains were individually activated in BHI broth (20h at 37°C) from frozen glycerol stock cultures. Activated working cultures were transferred again into BHI broth and incubated for 1d at 37°C. After the cultures were grown separately, for each strain the cfu/ml was determined (selective *Salmonella* plates) in order to make a 1:1 mix of these 2 cultures for the cocktail. Additionally, this mixture was diluted into 0.1% peptone water to yield a desired target level for inoculation. *Salmonella* inoculation was done by injection through a rubber septum, maintaining the integrity of modified atmospheric packaging. At three different places, a total amount of 1ml inoculum was added to each pattie (80 gram). Inoculated samples were stored following temperature scheme: 18 days at 7°C and from day 19 up to 30 days at 9°C. In parallel non inoculated samples were analysed for presence of *Salmonella*.

MEASUREMENT OF SENSORY CHARACTERISTICS

Sensory evaluation was done by determining the difference from control. Before presenting the samples to our panel, the raw products were grilled (salamander) until an internal core temperature of 72°C was reached. The samples were presented with a 3-digit code in randomized order. The results were analyzed with Least Significant Difference analysis.

III. RESULTS AND DISCUSSION

The goal of this study was to evaluate the antimicrobial potential of a clean label intervention in fresh chicken application. Addition of the Vinegar & Jasmin tea extract reduced the water activity of the sample. For the pH of the final products, addition of Vinegar & Jasmin tea extract led to a slight increase in pH value (see Table 1).

Table 1 Proximate analysis of the batches

Batch	aw	pH
Control	0.985	5.95
0.7% Vinegar & Jasmin tea extract	0.979	6.04

The APC, LAB and *Enterobacteriaceae* counts for the two different treatments as a function of storage time are shown in figure 1 a-d respectively. Several initial APC values have been reported in literature as acceptable. Such differences in initial APC values may be attributed to hygiene conditions in the poultry slaughtering and processing plant. In this test we observed an initial APC load between 3.2-3.5 log cfu/gram which is acceptable in fresh chicken meat. The APC counts exceeded the 7 log cfu/g, considered as the upper microbial limit for foods as defined by the ICMFS (1986) on day 12-13 for the control batch packed under modified atmosphere. Addition of 0.7% Vinegar & Jasmin tea blend doubled the shelf life and exceeded the 7 log cfu/gram at day 24.

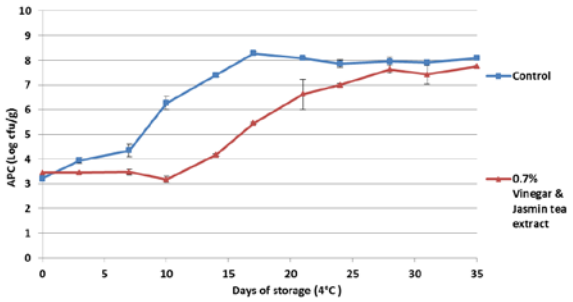

Fig 1-a. effect of Vinegar & Jasmin tea extract on APC stored at 4°C

LAB metabolism can result in off flavors caused by lactic acid production, as well of blowing of packages due to gas formation. Initial LAB counts (3 log cfu/g) increased in time during shelf life of the products. The control batch exceeded the value of 7 log cfu/g at day 14. The clean label intervention was able to delay the outgrowth of Lactic acid bacteria. The batch with Vinegar & Jasmin tea extract exceeded the value of 7 log cfu/g at day 22-23.

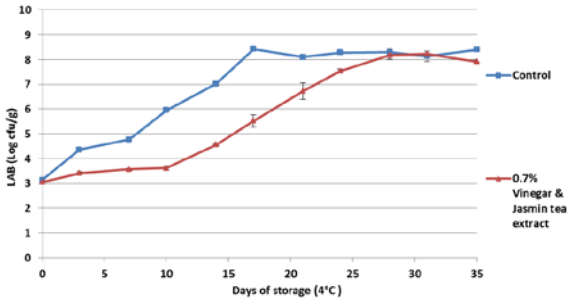

Fig 1-b. effect of Vinegar & Jasmin tea extract on LAB stored at 4°C

The initial population of *Enterobacteriaceae* counts in this test was between 1.8-2.5 log cfu/g for different treatments. In the control treatment we observed outgrowth of *Enterobacteriaceae* around day 7; while Vinegar & Jasmin tea extract was able to control the outgrowth of *Enterobacteriaceae* over the entire shelf life of 35 days.

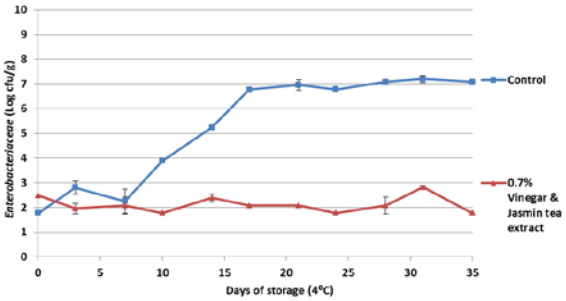

Fig 1-c effect of Vinegar & Jasmin tea extract on *Enterobacteriaceae* stored at 4°C

From analyzes of the non-inoculated samples we can conclude the chicken meat used for this test did not have detectable *Salmonella* counts. The microbial standard for *Salmonella sp.* in fresh meat requires it to be absence in 25 gram sample. In Fig 2 the inoculated *Salmonella* counts for the two different treatments as a function of storage time are shown. In the control batch an immediate growth of *Salmonella* is observed and the counts reach 6 log cfu/g levels at 15 days of storage. The combination of Vinegar & Jasmin tea extract was able to control the growth of *Salmonella* over the entire shelf life of 30 days.

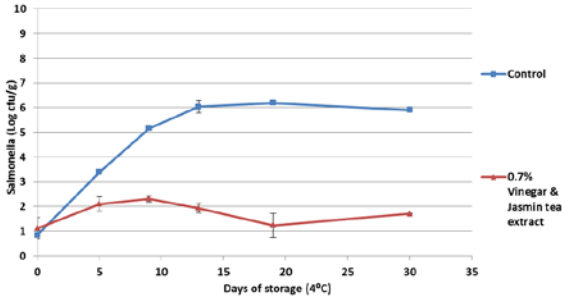

Fig 2. effect of Vinegar & Jasmin tea extract on *Salmonella* stored at 4°C

No significant differences between the tested batches were observed by an internally trained meat panel on taste using a difference from control test (table 2).
Also on color stability no visual differences were observed.

Table 2 Sensory analysis of the batches

Batch	Mean (n=10)	LSD
Control	1.88a	
0.7% Vinegar & Jasmin tea extract	2.50a	0.97

a=not-significant (p>0.10)

IV. CONCLUSION

Microbial and sensory data reported in the present study show that the addition of a blend of Vinegar & Jasmin tea extract had a positive effect on the shelf life of fresh chicken patties and gives the meat industry an option for a clean label antimicrobial intervention.
For APC counts we saw an extension of shelf life from 12 days using Vinegar & Jasmin tea extract.
For LAB Vinegar & Jasmin tea extract provided an extension of 9 days. Analyses for *Enterobacteriaceae* and *Salmonella* showed no growth over entire shelf life when using the Vinegar & Jasmin tea extract compared to control samples, which had seen fast outgrowth for all the above micro-organisms. This indicates that the Vinegar & Jasmin tea do not only contribute to shelf life extension but also to food safety of fresh chicken products.

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