ACID WHEY CONCENTRATE AS A CARRIER FOR LACTOBACILLUS PARACASEI 11 FOR FRESH CHEESE MICROBIOLOGICAL QUALITY

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Abstract - The demand for healthy foods without artificial food additivesis constantly increasing.Naturally preserved food by using bioprotective cultures could be an alternative for chemical preservatives. Indigenous antimicrobial Lactic as eibacillus paracasei A11 strain with broad spectrum of antifungal activity in vitrowas selectedas a model strain for cultivation in liquid acid whey protein concentrate (AWPC) to be used in liquid and freeze-dried form on fresh acid-curd cheese for its quality maintenance. Plain AWPC and resultant fermentate (10^8 cfu/ml) in wet and freeze-dried form were tested for their bioprotection properties on fresh acid-curd cheese. AWPC fermentates with L. paracasei A11 strain were able to significantly reduce yeast, mold, and enterobacteria counts by 1 log ($p \leq 0.05$), diminishing off-flavors during extended storage, thus prolonged cheese shelf-life up to 6 days.

Keywords – Lactic as Eibacill us Paracasei, Acid Way Protein Concentrate, Fermentates, Acid-Curd Cheese, Bioprotection.

I. RESULTS AND DISCUSSION

The acid whey protein concentrate and its fermentate with L. paracasei A11 (6.0 - 7.0 log CFU/g after 48 h of cultivation) were used for cheese protection experiments in original (wet) form and after freeze-drying.To test the bioprotective properties of the AWPC and its fermentate they were deposited on the surface offresh acid-curd cheese.The study showedthatcheesestorage time and treatment factors, and their interaction had a significant impact ($P \leq 0.001$) on pH, microbiological parameters, and overall acceptability of acid-curd cheese (Figure 1).Curd cheese is known for its soft, grainy texture and sour flavor mainly due to metabolic activity of starter and non-starter lactic acid bacteria(LAB) (Colombo et al., 2020). Our study showed no significant difference in active acidity (pH) among cheese samples on day 1 (Fig. 1a).Up until day 8 pH increased and then decreased only in control untreated cheese due to natural protein hydrolysis(Mileriene et al., 2021). All the experimental samples that were covered with AWPC fermentates demonstrated a decrease in pH on day 8 and then increase on day 14. We speculate, that natural curd cheese proteolysis was slowed down in experimental cheese samples due to the addition of AWPC. L. paracaseiA11 AWPC fermentate, especially in a freeze-dried form, affected the pH dynamic of modified cheese: it decreased significantly more on day 8 ($P \leq 0.001$) and increased on day 14 ($P \leq 0.05$) compared to only AWPC covered samples. Nostatistical differences in pH among samples were found on Day 14.Throughout the storage we observed steady growth of LAB with counts varying among control, sprayed (wet) and dusted (freeze-dried) experimental samples. LAB counts increased significantly in control and plain AWPC sprayed samples till day 8 followed by insignificant growth till the end of storage (Fig. 1b). Cheese with wet AWPC fermentate(C+AWPC+A11) demonstratedless vigorous increase in LAB counts up to the end of storage ($P \leq 0.05$), while freeze-dried AWPC and its fermentate slowed down LAB growth significantly throughout the storage of cheese. Due to low pH (4.4-4.6), high moisture content (51,53 %) and manual operations fresh curd cheese is very prone to microbial spoilage resulting in off-flavors and short shelf-life – 7-8 days (Mileriene et al, 2021). We detected rapid growth of fungi and enterobacteria in all our samples, reaching 7.4-7.6 log cfu/g and 3.1-3.9 log cfu/g at the end of storage, respectively. Freeze-dried AWPC and both wet and freeze-dried AWPC fermentates were able to reduce yeast (Fig. 1c) and mold (Fig. 1d) counts by 1 log ($P \leq 0.001$) on day 8As on starting day (Day 1), there was no significant difference among samples in the counts of fungi at the end of experiment (Day 14). We detected significantly lower counts of enterobacteria in all experimental cheese samples during their storage (Fig. 1e). Antimicrobial activity of some LAB and propionic acid bacteriastrains intended for food

protection and preservation was reported by other researchers and such strains are already employed in commercial fermentates such asMicroGARD (DuPont Danisco) and DuraFresh (Kerry). As an example, MicroGARD is produced by skimmed milk fermentation using P.freudenreichiiis ablepartially inhibit spoilage microflorain cottage cheese and thus extend its shelf-life (Garnier et al., 2017).Sensory defects in fresh curd cheese are often caused by yeasts and mold contamination (Garnier et al., 2017), thus bioprotective cultures are employed to prevent the spoilage and preserve the flavor of the product. LAB cultures, especially if used in a form of fermentates containing antifungal metabolites, may have a negative influence on sensory parameters and thus noticed by the consumer.

Overall acceptability of acid-curd cheese in our experiment were evaluated in the beginning and in the end of storage. All experimental samples, especially AWPC fermentate in its wet form (C+AWPC+A11 (w)), resulted in significantly higher acceptability scores than the control cheese ($P \leq 0.05$)(Fig. 1f).

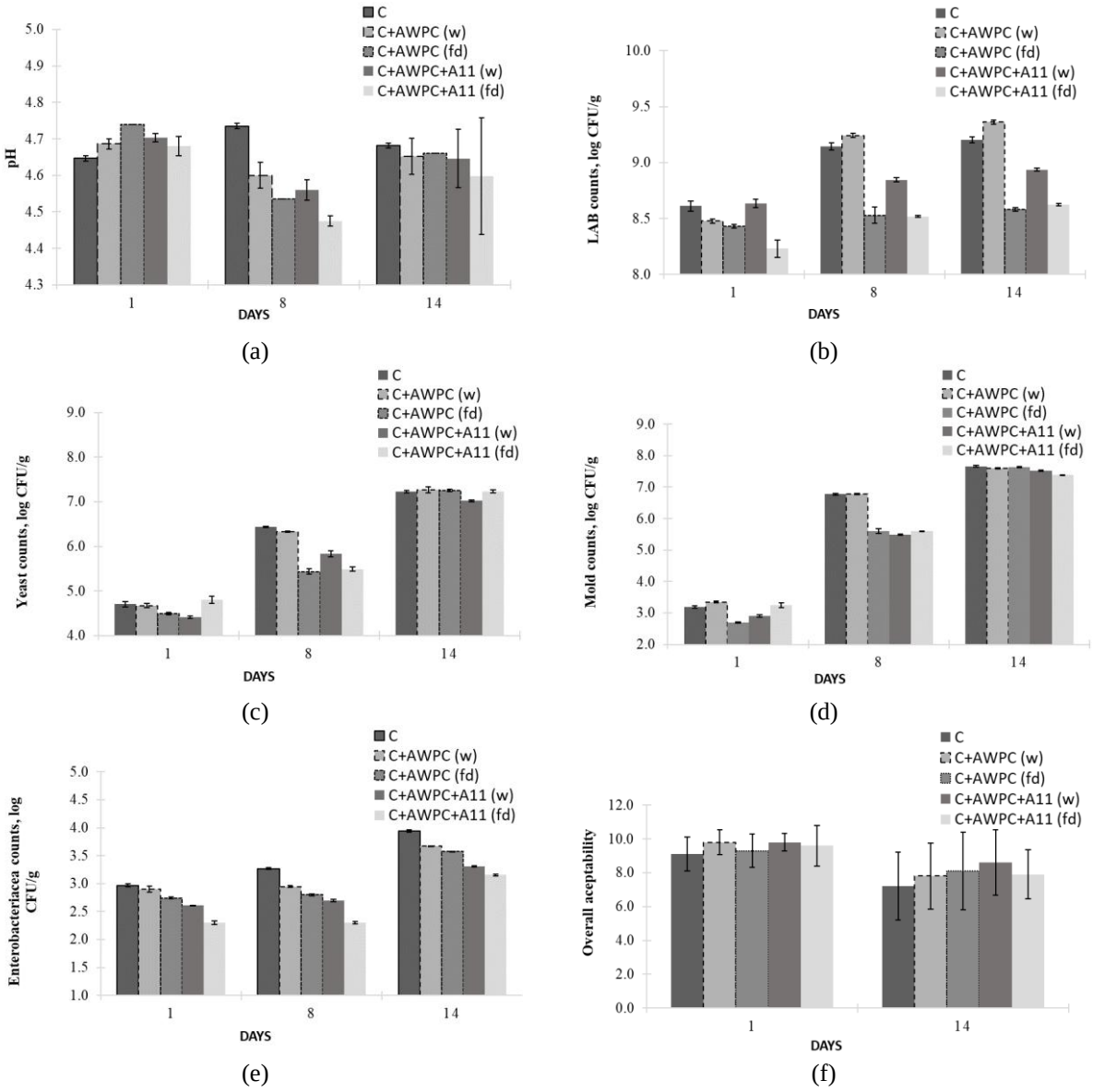


Figure1. pH (a), counts of lactic acid bacteria (LAB) (b), yeasts (c), molds (d), and enterobacteria (e), and overall acceptability (f) are presented for control curd cheese (C), curd cheese with wet (C+AWPC (w)) and freeze-dried (C+AWPC (fd)) AWPCs, and cheese with wet (C+AWPC+A11 (w)) and freeze-dried (C+AWPC+A11 (fd)) L.paracasei A11 fermentate during 14 days of storage at 4-6 ˚C

Application of AWPC based L.paracasei A11 fermentateas an adjunct culture proved to be an efficient in enhancing fresh acid-curd cheese flavor, inhibiting growth of spoilage microorganisms and prolonging its shelf life up to 6 days. Using AWPC instead of milk for the commercial cultivation of protective strains may enable reusing dairy waste acid whey and its products.

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