

December 17, 2007

Volume XXI No. 5

EFFECT OF CUTTING TIME, TEMPERATURE, AND CALCIUM ON CURD MOISTURE, WHEY FAT LOSSES, AND CURD YIELD BY RESPONSE SURFACE METHODOLOGY

*C. C. Fagan, M. Castillo, F. A. Payne, C. P. O'Donnell and D. J. O'Callaghan
J. of Dairy Sci. 90(10): 4499. 2007.*

Response surface methodology was used to study the effect of temperature, cutting time, and calcium chloride addition level on curd moisture content, whey fat losses, and curd yield. Coagulation and syneresis were continuously monitored using 2 optical sensors detecting light backscatter. The effect of the factors on the sensors' response was also examined. Retention of fat during cheese making was found to be a function of cutting time and temperature, whereas curd yield was found to be a function of those 2 factors and the level of calcium chloride addition. The main effect of temperature on curd moisture was to increase the rate at which whey was expelled. Temperature and calcium chloride addition level were also found to affect the light backscatter profile during coagulation whereas the light backscatter profile during syneresis was a function of temperature and cutting time. The results of this study suggest that there is an optimum firmness at which the gel should be cut to achieve maximum retention of fat and an optimum curd moisture content to maximize product yield and quality. It was determined that to maximize curd yield and quality, it is necessary to maximize firmness while avoiding rapid coarsening of the gel network and microsineresis. These results could contribute to the optimization of the cheese-making process.

NONSTARTER LACTOBACILLUS STRAINS AS ADJUNCT CULTURES FOR CHEESE MAKING: IN VITRO CHARACTERIZATION AND PERFORMANCE IN TWO MODEL CHEESES

*M. Briggiler-Marcó, M. L. Capra, A. Quiberoni, G. Vinderola, J. A. Reinheimer and E. Hynes
J. of Dairy Sci. 90(10): 4532. 2007.*

Nonstarter lactic acid bacteria are the main uncontrolled factor in today's industrial cheese making and may be the cause of quality inconsistencies and defects in cheeses. In this context, adjunct cultures of selected lactobacilli from nonstarter lactic acid bacteria origin appear as the best alternative to indirectly control cheese biota. The objective of the present work was to study the technological properties of Lactobacillus strains iso-

lated from cheese by in vitro and in situ assays. Milk acidification kinetics and proteolytic and acidifying activities were assessed, and peptide mapping of trichloroacetic acid 8% soluble fraction of milk cultures was performed by liquid chromatography. In addition, the tolerance to salts (NaCl and KCl) and the phage-resistance were investigated. Four strains were selected for testing as adjunct cultures in cheese making experiments at pilot plant scale. In in vitro assays, most strains acidified milk slowly and showed weak to moderate proteolytic activity. Fast strains decreased milk pH to 4.5 in 8 h, and continued acidification to 3.5 in 12 h or more. This group consisted mostly of *Lactobacillus plantarum* and *Lactobacillus rhamnosus* strains. Approximately one-third of the slow strains, which comprised mainly *Lactobacillus casei*, *Lactobacillus fermentum*, and *Lactobacillus curvatus*, were capable to grow when milk was supplemented with glucose and casein hydrolysate. Peptide maps were similar to those of lactic acid bacteria considered to have a moderate proteolytic activity. Most strains showed salt tolerance and resistance to specific phages. The *Lactobacillus* strains selected as adjunct cultures for cheese making experiments reached 10⁸ cfu/g in soft cheeses at 7 d of ripening, whereas they reached 10⁹ cfu/g in semihard cheeses after 15 d of ripening. In both cheese varieties, the adjunct culture population remained at high counts during all ripening, in some cases overcoming or equaling primary starter. Overall, proximate composition of cheeses with and without added lactobacilli did not differ; however, some of the tested strains continued acidifying during ripening, which was mainly noticed in soft cheeses and affected overall quality of the products. The lactobacilli strains with low acidifying activity showed appropriate technological characteristics for their use as adjunct cultures in soft and semihard cheeses.

UTILIZATION OF MICROFILTRATION OR LACTOPEROXIDASE SYSTEM OR BOTH FOR MANUFACTURE OF CHEDDAR CHEESE FROM RAW MILK

Y. Amornkul and D. R. Henning

J. of Dairy Sci. 90(11): 4988. 2007.

The objective was to determine if application of microfiltration (MF) or raw milk lactoperoxidase system (LP) could reduce the risk of foodborne illness from *Escherichia coli* in raw milk cheeses, without adversely affecting the overall sensory acceptability of the cheeses. *Escherichia coli* K12 was added to raw milk to study its survival as a non-pathogenic surrogate organism for pathogenic *E. coli*. Five replications of 6 treatments of Cheddar cheese were manufactured. The 6 treatments included cheeses made from pasteurized milk (PM), raw milk (RM), raw milk inoculated with *E. coli* K12 (RME), raw milk inoculated with *E. coli* K12 + LP activation (RMELP), raw milk inoculated with *E. coli* K12 + MF (MFE), and raw milk inoculated with *E. coli* K12 + MF + LP activation (MFELP). The population of *E. coli* K12 was enumerated in the cheese milks, in whey/curds during cheese manufacture, and in final Cheddar cheeses during ripening. Application of LP, MF, and a combination of MF and LP led to an average percentage reduction of *E. coli* K12 counts in cheese milk by 72, 88, and 96%, respectively. However, *E. coli* K12 populations significantly increased during the manufacture of Cheddar

cheese for the reasons not related to contamination. The number of *E. coli* K12, however, decreased by 1.5 to 2 log cycles during 120 d of ripening, irrespective of the treatments. The results suggest that MF with or without LP significantly lowers *E. coli* count in raw milk. Hence, if reactivation of *E. coli* during cheese making could be prevented, MF with or without LP would be an effective technique for reducing the counts of *E. coli* in raw milk cheeses. The cheeses were also analyzed for proteolysis, starter and nonstarter lactic acid bacteria (NSLAB), and sensory characteristics during ripening. The concentration of pH 4.6 soluble nitrogen at 120 d was greater in PM cheese compared with the other treatments. The level of 12% trichloroacetic acid-soluble nitrogen at 120 d was greater in RM, RME, and RMELP cheeses compared with PM, MFE, and MFELP cheeses. This could be related to the fact that cheeses made from raw milk with or without LP (RM, RME, and RMELP) had greater levels of NSLAB compared with PM, MFE, and MFELP cheeses. Cheeses at 60 d, as evaluated by 8 trained panelists, did not differ in bitterness, pastiness, or curdiness attributes. Cheeses at 120 d showed no differences in acid-taste, bitterness, or curdiness attributes. Sensory analysis at 60 d showed that PM and MFELP cheeses had greater overall sensory acceptability than RM and RME cheeses. The overall sensory acceptability of the cheeses at 120 d showed that PM, MFE, and MFELP cheeses were more acceptable than RM and RME cheeses.

SENSORY PROPERTIES OF MEAL REPLACEMENT BARS AND BEVERAGES MADE FROM WHEY AND SOY PROTEINS

J.L. Childs, M.D. Yates, and M.A. Drake

J. of Food Sci. 72(6): S425. 2007.

Whey and soy proteins have a variety of applications. Previous work has documented flavors of rehydrated whey and soy proteins. It is necessary to understand what flavors whey and soy proteins contribute to product applications to optimize protein performance in desired applications. This research was conducted to characterize sensory properties of meal replacement products containing whey and soy proteins. Flavor and texture lexicons were developed for meal replacement bars and beverages. Commercial peanut butter-flavored meal replacement bars and vanilla meal replacement shakes were evaluated by an experienced, trained descriptive panel ($n = 9$). Prototypes of bars and beverages were developed with 3 levels of whey and soy protein and subsequently evaluated. Consumer acceptance testing ($n = 85$) was conducted on the prototype bars and beverages. Protein type as well as product-specific formulation contributed differences in flavor and texture of commercial bars and beverages ($P < 0.05$). Sensory properties of prototype bars and beverages fell within the spectrum of commercial products. Prototype bars made with whey protein were characterized by sweet aromatic and vanillin flavor notes while the texture was characterized by adhesiveness and cohesiveness. Prototype bars made with soy protein were characterized by nutty flavor while the texture was characterized by tooth-pack and denseness. Whey protein contributed to sweet aromatic and vanillin flavors in prototype beverages while soy protein contributed cereal/grainy flavors. Consumer acceptance scores were higher for prototype bars and

beverages containing whey protein or a mixture of whey/soy protein than for products made with soy protein alone ($P < 0.05$). These results will aid researchers and product developers in optimizing sensory quality in meal replacement products.

PHYSICAL PROPERTIES OF WHEY PROTEIN COATING SOLUTIONS AND FILMS CONTAINING ANTIOXIDANTS

J.H. Han and J.M. Krochta

J. of Food Sci. 72(5): E308. 2007.

Antioxidants (ascorbyl palmitate and α -tocopherol) were incorporated into 10% (w/w) whey protein isolate (WPI) coating solution containing 6.67% (w/w) glycerol (WPI:glycerol = 6:4). Before incorporation, the antioxidants were mixed using either powder blending (Process 1) or ethanol solvent-mixing (Process 2). After the antioxidant mixtures were incorporated into heat-denatured WPI solution, viscosity and turbidity of the WPI solutions were determined. The WPI solutions were dried on a flat surface to produce WPI films. The WPI films were examined to determine transparency and oxygen-barrier properties (permeability, diffusivity, and solubility). WPI solution containing antioxidants produced by Process 1 and Process 2 did not show any difference in viscosity and turbidity, but viscosity was greater for the WPI solution with rather than without antioxidants. WPI films produced by Process 2 were more transparent than the films produced by Process 1. Oxygen permeability of Process 1 film was lower than Process 2 film. However, both the diffusivity and solubility of oxygen were statistically the same in Process 1 and Process 2 films. Both control WPI films and antioxidant-containing WPI films had very low oxygen solubility, comparable to polyethylene terephthalate films. Permeability of antioxidant-incorporated films was not enhanced compared to control WPI films.

THE EFFECT OF NATURAL CHEDDAR CHEESE RIPENING ON THE FUNCTIONAL AND TEXTURAL PROPERTIES OF THE PROCESSED CHEESE MANUFACTURED THEREFROM

C.A. Brickley, M.A.E. Auty, P. Piraino, and P.L.H. McSweeney

J. of Food Sci. 72(9): C483. 2007.

Cheddar cheese ripened at 8 °C was sampled at 7, 14, 28, 56, 112, and 168 d and subsequently used for the manufacture of processed cheese. The cheddar cheese samples were analyzed throughout ripening for proteolysis while the textural and rheological properties of the processed cheeses (PCs) were studied. The rate of proteolysis was the greatest in the first 28 d of cheddar cheese ripening but began to slow down as ripening progressed from 28 to 168 d. A similar trend was observed in changes to the texture of the PC samples, with the greatest decrease in hardness and increase in flowability being in the first 28 d of ripening. Confocal scanning laser microscopy showed that the degree of emulsification in the PC samples increased as the maturity of the cheddar cheese ingredient increased from 7 to 168 d. This increased emulsification resulted in a reduc-

tion in the rate of softening in the PC in samples manufactured from cheddar cheese bases at later ripening times. Multivariate data analysis was performed to summarize the relationships between proteolysis in the cheddar cheese bases and textural properties of the PC made therefrom. The proportion of α_{s1} -casein (CN) in the cheddar cheese base was strongly correlated with hardness, adhesiveness, fracturability, springiness, and storage modulus values for the corresponding PC. Degradation of α_{s1} -CN was the proteolytic event with the strongest correlation to the softening of PC samples, particularly those manufactured from cheddar cheese in the first 28 d of ripening.

ANTIMICROBIAL EFFICACY OF EUGENOL MICROEMULSIONS IN MILK AGAINST LISTERIA MONOCYTOGENES AND ESCHERICHIA COLI O157:H7

*S. Gaysinsky, T. M. Taylor, P. M. Davidson, B. D. Bruce and J. Weiss
J. of Food Protection 70(11): 2631. 2007.*

The antimicrobial activity of eugenol microemulsions (eugenol encapsulated in surfactant micelles) in ultrahigh-temperature pasteurized milk containing different percentages of milk fat (0, 2, and 4%) was investigated. Antimicrobial microemulsions were prepared from a 5% (wt) aqueous surfactant solution (Surfynol 485W) with 0.5% (wt) eugenol. Two strains each of *Listeria monocytogenes* and *Escherichia coli* O157:H7 previously shown to be the least and most resistant to the microemulsion in microbiological media were used to inoculate sterile milk (10^4 CFU/ml). Samples were withdrawn and plated at 0, 1, 3, 6, 12, and 24 h for enumeration. Microemulsions completely prevented growth of *L. monocytogenes* for up to 48 h in skim milk and reduced both strains of *E. coli* O157:H7 to less than detectable levels in less than 1 h. Similarly, in 2% fat milk, eugenol-Surfynol combinations reduced both strains of *E. coli* O157:H7 to less than detectable levels in less than 1 h but only increased the lag phase of both strains of *L. monocytogenes*. In full-fat milk (4% fat), microemulsions inhibited growth of the least resistant strains of *L. monocytogenes* and *E. coli* but were ineffective against the two resistant strains. Unencapsulated eugenol was slightly more or as inhibitory as microemulsions against target pathogens. Results were attributed to diffusional mass transport of antimicrobials from microemulsions to the macroemulsion (milk). Results suggest that food composition, especially fat level, may affect the efficiency of targeting of foodborne pathogens with surfactant-encapsulated antimicrobials.