International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **17**(01): 61-65, March 2024
DOI: 10.30954/0974-1712.01.2024.9

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Syneresis Attributes of Cow Milk Curd Prepared using various Curd Microflora as the Starter Culture

Poorani Arunachalam[1*], Pandian Chinnusamy, Elango Ayyasamy and Pugazhenthi Thirumalai Rengasamy

Department of Livestock Products Technology, Veterinary College and Research Institute, Udumalpet

*Corresponding author: pooraniarunachalam@gmail.com (**ORCID ID:** 0000-0001-5331-4669)

Paper No. 1111 **Received:** 24-11-2023 **Revised:** 20-02-2024 **Accepted:** 02-03-2024

ABSTRACT

Synerersis is of great influence in affecting curd yield and its quality. This research aimed evaluate the effect of different lactic starter culture and temperature of curd incubation on the Syneresis of cow milk curd. Different lactic cultures procured from National Dairy Research Institute, Karnal and the effect of different lactic starter cultures on cow milk curd Syneresis prepared under different incubation temperature of cow milk curd fermentation were studied. Lower syneresis values were observed in the cow milk curd samples prepared using *Lactococcus lactis* subsp. *lactis, Lactococcus lactis* subsp. *cremoris* and *Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* combined cultures. Cow milk curd prepared under incubation temperature of 37ºC exhibited lesser syneresis.

HIGHLIGHTS

- Developing curd with reduced syneresis by using different lactic culture as starter culture is the major objective of this research paper.
- Investigation using different lactic cultures as stater under incubation temperature of 37°C and 40 °C was carried out separately.
- Lower syneresis values in cow milk curd were observed in the cow milk curd samples prepared using *Lactococcus lactis* subsp. *lactis, Lactococcus lactis* subsp. *cremoris* and *Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* combined cultures at 37ºC.

Keywords: Syneresis, Cow milk curd, fermentation, incubation temperature, lactic cultures

Curd is traditionally produced using a mixture of lactic starter cultures. Curd being a popular fermented dairy product needs to be commercialized on a large scale (Mudgal and Prajapati, 2017). Popularity of fermented milks is attributed to its taste as well as its external appearance. Syneresis in the final product is very often is undesired especially in commercial production of curd (Sankhla *et al.* 2022). Hence, it is necessary to investigate under what conditions syneresis can be minimised/prevented.

Syneresis is an essential step in the production of curd from lactic cultures (Chaudhary *et al.* 2018; Mahmood *et al.* 2019). In this research different lactic cultures were selected and their effect on syneresis at various commercial incubation temperatures were studied in detail.

Syneresis in cow milk curd can be influenced by the type of starter cultures used for fermentation, the protolithic activity, production of extracellular polysaccharides by the starter cultures used for curd fermentation and inoculation rate (Arab *et al.* 2023; Gumber *et al.* 2024). Moreover, optimizing

How to cite this article: Arunachalam, P., Chinnusamy, P., Ayyasamy, E. and Rengasamy, P.T. (2024). Syneresis Attributes of Cow Milk Curd Prepared using various Curd Microflora as the Starter Culture. *Int. J. Ag. Env. Biotech.*, **17**(01): 61-65.

Source of Support: None; **Conflict of Interest:** None

the usage of selective starter culture and incubation temperature will definitely improve the curd quality by reducing its syneresis (Sankhla *et al.* 2022).

Control of syneresis in curd is vital thing as it allows the curd manufacturer to control the moisture content of the curd (Ziarno *et al.* 2022). Syneresis has its role in texture, flavour, quality as well as appeal of the curd (Kumar *et al.* 2022). The composition of the milk, lactic cultures has the major impact on syneresis of curd; Reducing the fat content of milk used to prepare curd decreases the rate of Syneresis (Paramban Rahila *et al.* 2016; Ammiti *et al.* 2019).

Wheying-off /Whey Leakage / Syneresis/ from curd is frequently observed defect needs to be controlled in curd production. Syneresis is indicative of faulty fermentation and off flavors and it may be due high incubation temperature, excessive whey protein to casein ratio, low solids content and physical mishandling of the product during storage and retail distribution (Lucey, 2002).

Physical properties such as mouth-feel and the absence of whey separation are crucial factors that affect consumer perception (Lee and Lucey, 2010). These properties depend on the microstructural features of the yogurt, which can be altered by modifying the ingredient composition (Aguilera, 2005). To enhance cow milk curd in a natural and cost-effective manner, many consumers prefer natural and clean-label ingredients, avoiding thickeners and gelling agents (Modler & Kalab, 1983; Teggatz & Morris, 1990). One approach to improve curd properties naturally is to use lactic acid bacteria

MATERIALS AND METHODS

Syneresis of cow milk curd samples with different starter cultures prepared under different incubation temperature of 37°C and 40°C. As per the sensory panel cow milk curd containing 5 per cent Fat and 9 per cent SNF was selected as ideal combination for curd making.

The following starter cultures were used on the selected fat and SNF combinations for cow and buffalo milk for further studies.

Sl. No.	Treatment	Combinations	Replication
1	T1	*Lactococcus lactis* subsp. *Lactis*	6
2	T2	*Lactococcus lactis* subsp. *Cremoris*	6
3	T3	*Lactococcus lactis* subsp. *lactis biovar diacetylactis*	6
4	T4	*Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *lactis biovar diacetylactis*	6
5	T5	*Lactococcus lactis* subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis biovar diacetylactis*	6
6	T6	*Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis biovar diacetylactis*	6
7	T7	Leuconostoc lactis	6
8	T8	*Leuconostoc mesenteroides* subsp.*cremoris*	6
9	T9	*Leucuconostoc lactis* + *Leuconostoc mesenteroides* subsp. *Cremoris*	6
10	T10	Lactobacillus plantarum	6
11	T11	Brevibacillus brevis	6
12	T12	Lactobacillus paraplantarum	6
13	T13	*Streptococcus salivarius* subsp. *thermophilus*	6

Curd was prepared as per the procedure outlined by Raju and Pal (2009).

Flow diagram of preparation of curd

Fresh milk

↓

Standardization

↓

Heating standardized milk to 65°C

↓

Homogenization (2500 psi)

↓

Pasteurization (85°C for 30 min)

↓

Cooling to 37ºC/40ºC

↓

Inoculation of starter cultures (2 per cent)

↓

Filling into presterilized polystyrene cups with lids

↓

Incubation at 37±1°C / 40±1°C

↓

Reaching 0.66 to 0.72 per cent acidity

↓

Storage at temperature (4 ± 1°C)

Syneresis

Syneresis was estimated following the drainage method described by Chawla and Balachandran (1994). After about 16h of storage under refrigeration, the curd cups were taken out and tempered at 25°C for 2 h. With the help of a spatula, the contents of the cups were loosened from the sides and straight away emptied into a glass funnel with a Whatman No.1 filter paper. The funnel was placed on a graduated glass cylinder of 100 ml capacity. The funnel with a cylinder was kept at room temperature. The quantity of whey collected after 2 h of drainage was estimated as syneresis and expressed as the per cent whey separated.

RESULTS AND DISCUSSION

Syneresis (ml/100g) of cow milk curd samples prepared using different starter cultures incubated at 37 and 40°C is presented in Table 2.

Table 2: Syneresis (ml/100g) of cow milk curd samples prepared with various starter cultures incubated at 37°C and 40°C

Cow milk curd			
Incubation temperature			
37 °C		**40 °C**	
Treatments (n=6)	**Syneresis (ml/100g)**	**Treatments (n=6)**	**Syneresis (ml/100g)**
C1C	$10.50^{B} \pm 0.60$	C2C	$12.88^{C} \pm 0.60$
C1Ll	$10.53^{B} \pm 0.72$	C2Ll	$12.34^{B} \pm 0.72$
C1Lc	$11.32^{C} \pm 0.60$	C2Lc	$13.18^{D} \pm 0.72$
C1Ld	$10.68^{B} \pm 0.60$	C2Ld	$12.24^{B} \pm 0.75$
C1Ll + L1d	$10.52^{B} \pm 0.60$	C2Ll + Ld	$12.90^{C}0.60$
C1Lc + Ld	$11.50^{C} \pm 0.60$	C2Lc + Ld	$12.92^{C} \pm 0.60$
C1Ll + Lc + Ld	$9.47^{A} \pm 0.60$	C2Ll + Lc + Ld	$9.92^{A} \pm 0.72$
C1St	$11.51^{C} \pm 0.71$	C2St	$12.88^{C} \pm 0.71$

Mean values bearing different upper case superscripts in column differed significantly (P < 0.01).

Syneresis (ml/100g) for the cow milk curd samples incubated at 37 and 40°C ranged from 9.47 to 11.51 and 9.92 to 12.24, respectively (Fig. 1, 2 and 3). Lower syneresis values were observed in the curd samples prepared using *Lactococcus lactis* subsp. *lactis, Lactococcus lactis* subsp. *cremoris* and *Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* combined cultures.

Nguyen *et al*. (2014) who had stated that yoghurt produced from a faster fermentation at 43 °C was firmer with a more porous microstructure that exhibited a higher degree of syneresis.

Body and texture of curd containing *Lactococcus lactis* subsp. *lactis, Lactococcus lactis* subsp. *cremoris and Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* starter culture was characterized by firm homogenous gel and it was free from syneresis and posses typical white, smooth and shiny surface. These results are in agreements with the findings of Joon *et al.* (2017).

Jaros and Rohm (2003) analyzed that enhanced acidification to pH values below 4.0 may lead to body and texture defects such as gel shrinkage and Syneresis.

The syneresis of cow milk curd samples with different starter cultures prepared under different incubation temperature of 37°C exhibited significant difference (P<0.01) between the control and treatment samples. The data in table 2 indicated that cow milk curd sample with *Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris and Lactococcus lactis subsp. lactis biovar diacetylactis* culture showed lower syneresis of 9.47 ± 0.01 mg/100ml. The findings of this study is supported by Costa *et al*. (2012) who recorded that exopolysaccharide produced by certain strains of *L. lactis* were observed in the fermented product specifically located around the aqueous/air pores, possibly binds the extra water resulting in lower syneresis.

Syneresis of cow milk curd samples with different starter cultures incubated at 40°C exhibited significant difference (P<0.01) between the control and treatment samples. The data in table 2 indicated that cow curd containing *Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris and Lactococcus lactis subsp. lactis biovar diacetylactis* culture showed lower syneresis of 9.92 ± 0.02 mg/100 ml (Fig. 2).

The present investigation reveals that syneresis of cow milk curd samples with different starter

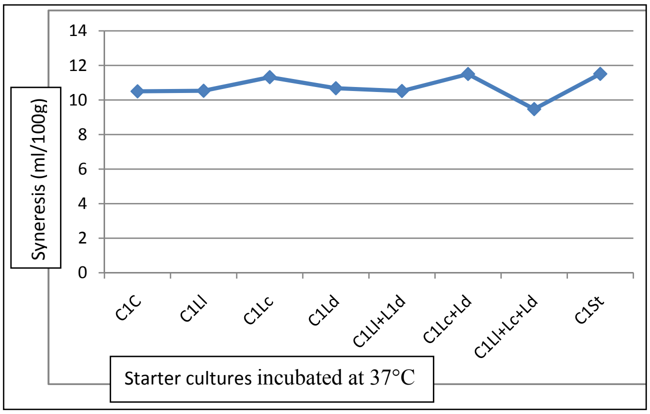

Fig. 1: Syneresis (ml/100g) of cow milk curd samples prepared with various starter cultures incubated at 37°C

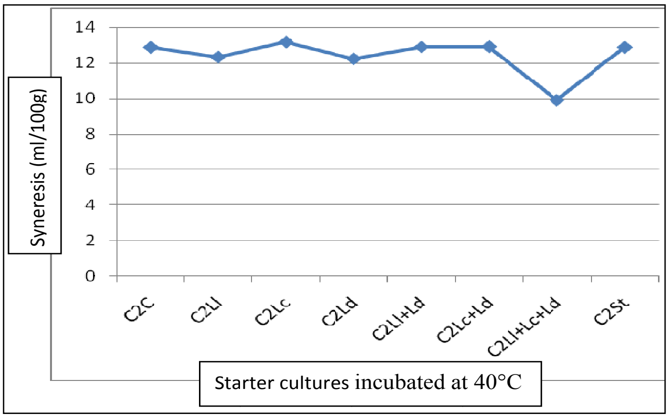

Fig. 2: Syneresis (ml/100g) of cow milk curd samples prepared with various starter cultures incubated at 40°C

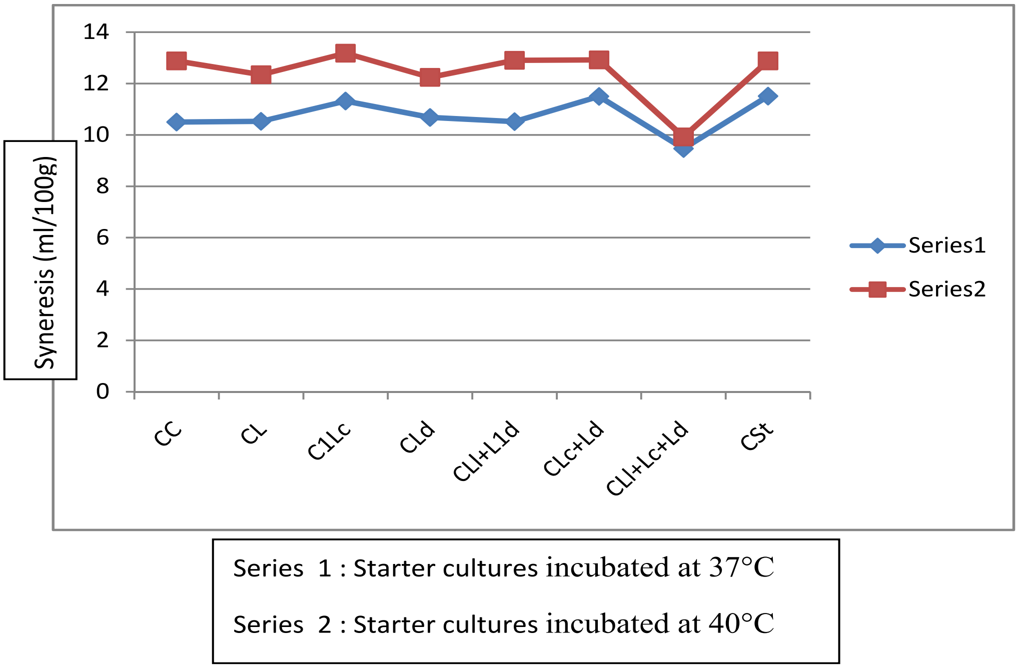

Fig. 3: Comparision of Syneresis (ml/100g) of cow milk curd samples prepared with various starter cultures incubated at 37°C and 40°C

cultures prepared under different incubation temperature of 37°C exhibited significant difference (P<0.01) between the control and treatment samples. The data in table 2 indicated that cow milk curd sample *Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris and Lactococcus lactis subsp. lactis biovar diacetylactis* showed lower syneresis of 9.47±0.60 mg/100ml. The findings of this study is supported by Costa *et al*. (2010) who had recorded that exopolysaccharide produced by certain strains of *L. lactis* were observed in the fermented product specifically located around the aqueous/air pores, possibly binds the extra water resulting in lower syneresis.

CONCLUSION

Based on the experiment results the variability in syneresis among the different starter cultures in cow milk curd *Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris and Lactococcus lactis subsp. lactis biovar diacetylactis* exhibited lower syneresis. Syneresis of cow milk curd samples with different starter cultures prepared under different incubation temperature of 37°C and 40°C exhibited significant difference (P<0.01) between the control and treatment samples and fermenting curd at incubation temperature of 37°C exhibited lesser syneresis than at 40°C.

ACKNOWLEDGEMENTS

Authors would like to thank Tamil Nadu Veterinary and Animal Sciences University for providing all the facilities during entire study period.

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