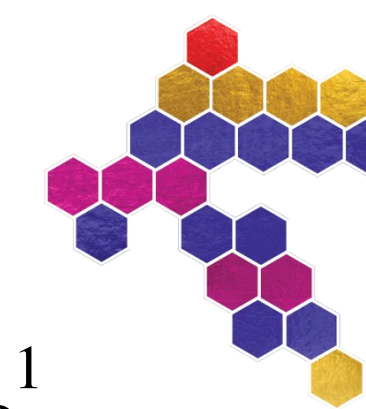




# Defining key physicochemical parameters affecting milk coagulation properties

Fabijan Oštarić<sup>1</sup>, Dario Domović<sup>1</sup>, Biljana Radeljević<sup>1</sup>, Neven Antunac<sup>1</sup>, Nataša Mikulec<sup>1</sup>

<sup>1</sup>University of Zagreb, Faculty of Agriculture, Svetošimunska cesta 25, 10 000 Zagreb, Croatia



4<sup>th</sup> International Congress  
on Food Safety and Quality  
**ONE HEALTH**

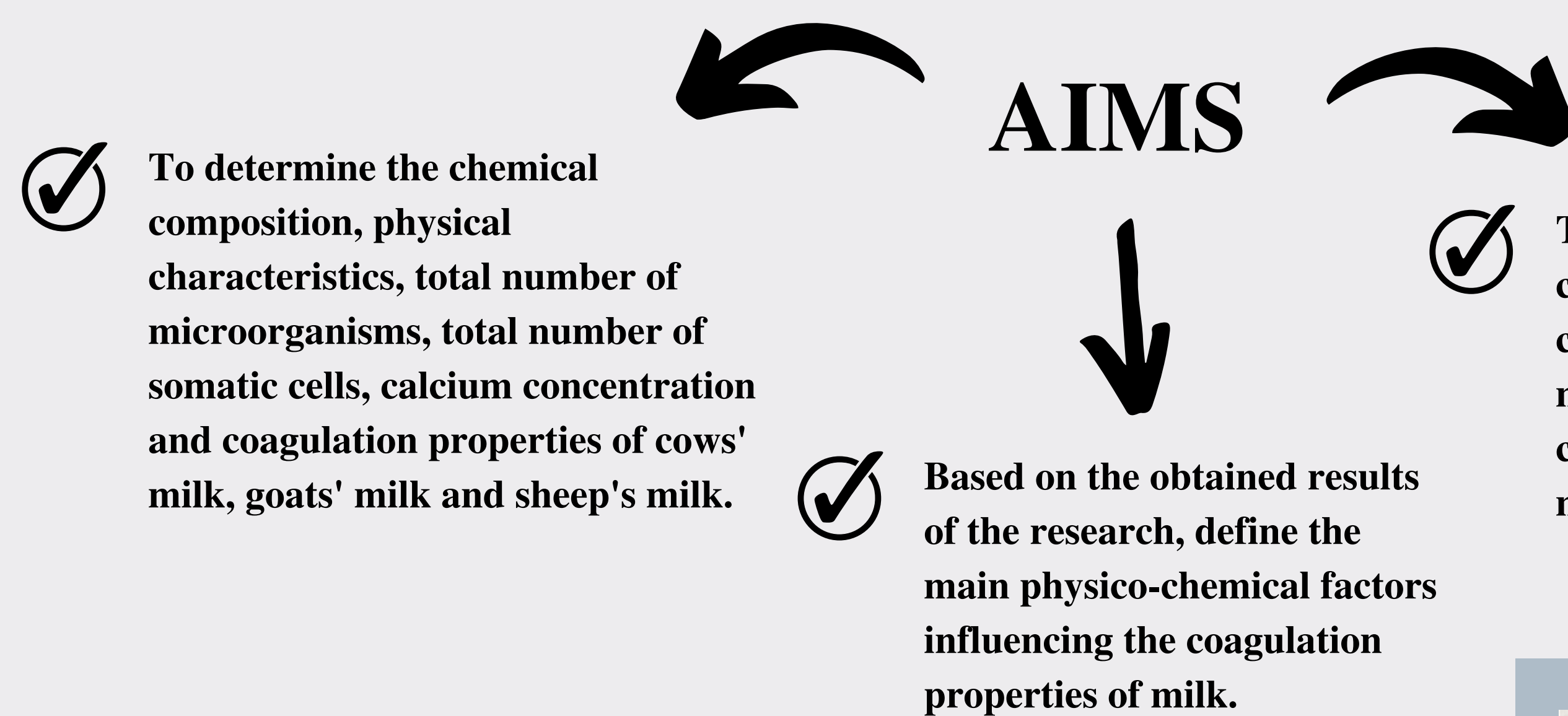
November 9<sup>th</sup>-12<sup>th</sup>, 2022 | Dubrovnik, Croatia

## INTRODUCTION

The main process in cheese production is milk coagulation. It is most often caused by rennet, a mix of proteolytic enzymes dominated by chymosin belonging to the acid aspartate proteinase group (EC. 3.4.23). There is a wide range of factors that may have a positive or negative influence on the coagulation process. Determination and knowledge of milk coagulation properties (MCP) give us an insight into the coagulation process, the factors affecting it, and the possibility to manipulate it to get the desired effects. Milk coagulation properties (MCP) are expressed through (i) time from rennet addition to the beginning of coagulation (RCT, min), (ii) time needed for the curd to obtain firmness (CF, mm) of 20 mm ( $k_{20}$ , min), and (iii) curd firmness at the end of the analysis ( $a_{30}$  or  $a_{60}$ , mm), and are measured with optical and mechanical methods (Bittante, 2011). This study determines the milk coagulation properties (MCP) of cow, goat, and sheep origin, which are primarily used in the production of traditional cheeses.



SAMPLING AREA



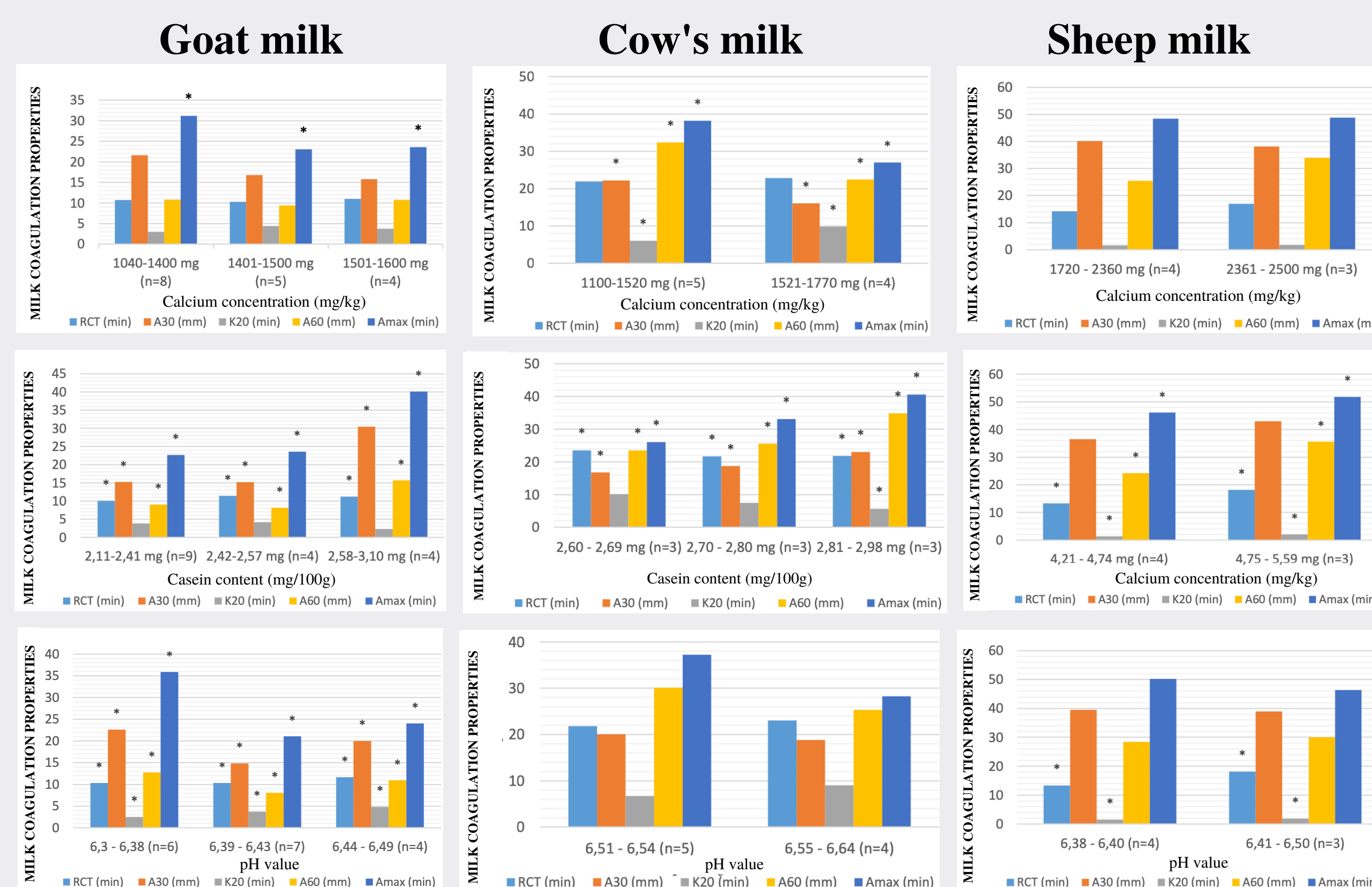
LABORATORY ANALYSES

### KEY PHYSICO-CHEMICAL PARAMETERS

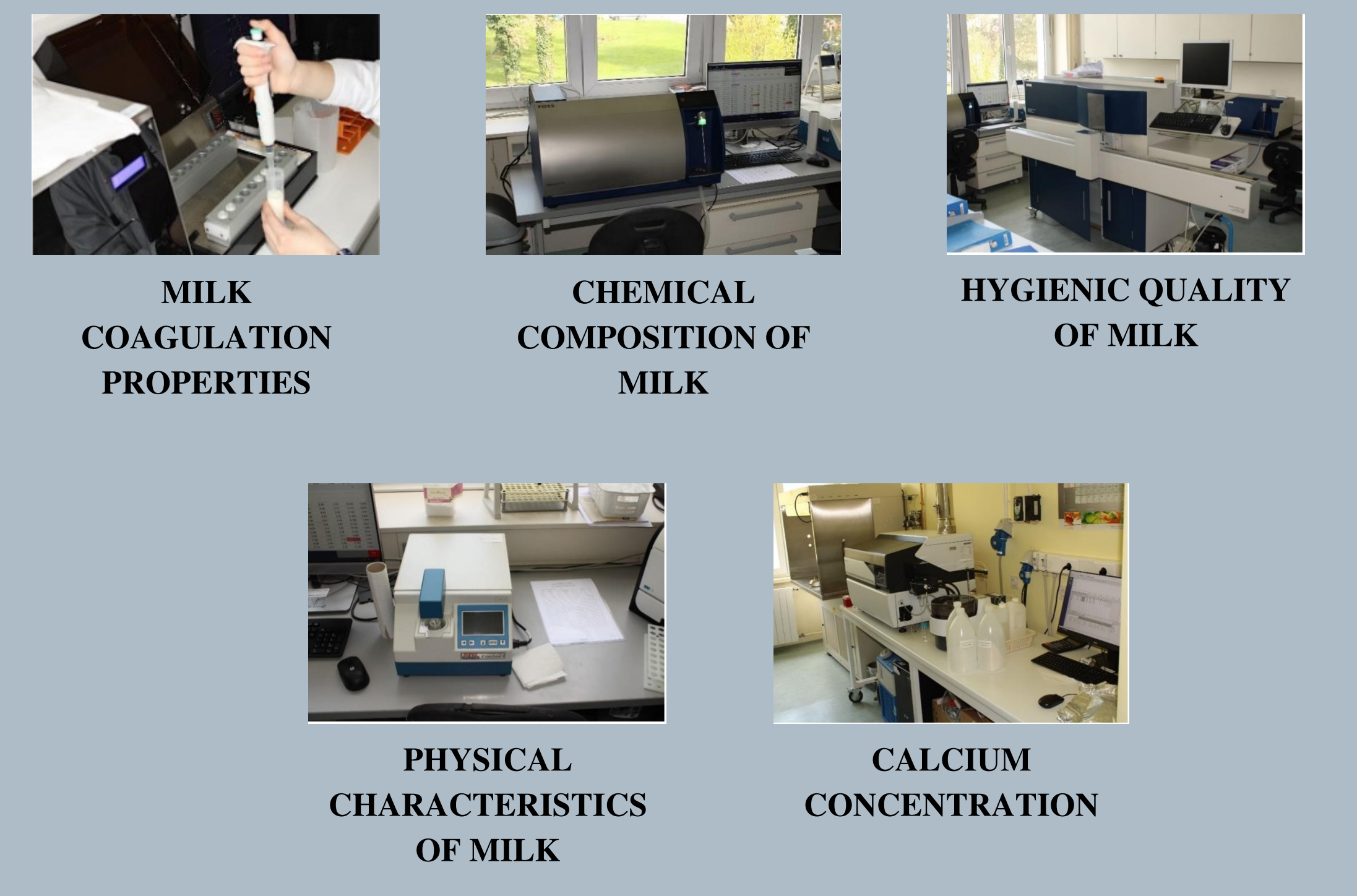
CALCIUM

CASEIN

IONOMETRIC ACIDITY OF MILK



\*p<0,05



Based on all obtained results, the key physico-chemical factors are casein content, calcium concentration and pH value of milk.

CHEMICAL INGREDIENT OF MILK	TYPE OF MILK AND NUMBER OF SAMPLES (n)		
	COW (n=9)	GOAT (n=17)	SHEEP (n=7)
Milk fat (g/100g)	4,35	3,71	6,62
Proteins (g/100g)	3,52	3,08	6,03
Lactose (g/100g)	4,61	4,40	4,47
Dry matter (g/100g)	13,42	11,75	17,88
Dry matter without fat (g/100g)	9,05	7,70	11,15
Casein (g/100g)	2,77	2,42	4,76
Citrate (g/100g)	0,162	0,061	0,117
Free fatty acids (mmol/L)	0,46	0,62	0,47
Urea (mg/dL)	10,67	26,76	19,86

PHYSICAL CHARACTERISTICS OF MILK	TYPE OF MILK AND NUMBER OF SAMPLES (n)		
	COW (n=9)	GOAT (n=17)	SHEEP (n=7)
Ionometric acidity (pH)	6,55	6,40	6,42
Freezing point (°C)	-0,5213	-0,5408	-0,5567
Density (g/L)	1029,34	1025,7	1034,62

HYGIENIC QUALITY OF MILK	TYPE OF MILK AND NUMBER OF SAMPLES (n)		
	COW (n=9)	GOAT (n=17)	SHEEP (n=7)
Total number of microorganisms (CFU/mL)	92 778	405 882	1 183 571
Total number of somatic cells (mL)	408 000	1 300 471	2 481 857

MINERAL COMPOSITION OF MILK	TYPE OF MILK AND NUMBER OF SAMPLES (n)		
	COW (n=9)	GOAT (n=17)	SHEEP (n=7)
Calcium (mg/kg)	1501,11	1387,65	2271,43

MILK COAGULATION PROPERTIES	TYPE OF MILK AND NUMBER OF SAMPLES (n)		
	COW (n=9)	GOAT (n=17)	SHEEP (n=7)
RCT (min)	22,34 <sup>a</sup>	10,64 <sup>b</sup>	15,41 <sup>c</sup>
a <sub>30</sub> (mm)	19,49 <sup>a</sup>	18,81 <sup>a</sup>	39,29 <sup>b</sup>
k <sub>20</sub> (min)	7,75 <sup>a</sup>	3,57 <sup>b</sup>	1,67 <sup>c</sup>
a <sub>60</sub> (mm)	27,98 <sup>a</sup>	10,40 <sup>b</sup>	29,12 <sup>a</sup>
a <sub>max</sub> (min)	33,25 <sup>a</sup>	27,00 <sup>b</sup>	48,58 <sup>c</sup>

\* a, b, c mean values in the same row of tables with different codes are significantly different (p < 0.001)

\* (RCT: coagulation start (min), a<sub>30</sub>: coagulation strength (mm), k<sub>20</sub>: coagulation formation rate (min), a<sub>60</sub>: strength at 60 minutes (mm), a<sub>max</sub>: maximum coagulation strength (min))

## RESULTS



## CONCLUSIONS

The coagulation properties of milk vary depending on the type of milking animals.

An increase in casein content has a positive effect on the clotting strength (> a<sub>30</sub> and a<sub>60</sub>).

Calcium concentrations mostly influenced the changes in coagulation properties in cow's milk.

The values of the initial pH of milk higher than optimum negatively affect the coagulation properties of sheep and goat milk.

Differences in chemical composition, physical characteristics, total number of microorganisms and somatic cells, and calcium concentration in cows, goats and sheep milk were found.

## ACKNOWLEDGMENTS

The research was done as part of the project:  
“Potential of microencapsulation in cheese production”, KK.01.1.1.04.0058.

The funding was ensured from the Operational Program Competitiveness and Cohesion 2014 – 2020. Investment in science and innovations - first call, KK.01.1.1.04.

## REFERENCE

1. Bittante (2011): Modeling rennet coagulation time and curd firmness of milk. Journal of Dairy Science, 94 (12), 5821-5832.

