

Impact of somatic cell score on milk composition, curd firming, and cheese-making traits of Manchega sheep

Heddi , I., Amalfitano, N., Cecchinato , A., Garzón, A., Caballero-Villalobos, J., Ramon, M.,. Perea, J.M.,Angón, E., Cantarero , M., Jiménez, L., Arias, R



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SPAIN: LA MANCHA

Manchega sheep



Mancha region

- Enhancing milk production is one of the primary objectives of their breeding program.
- Well-known for its milk production quality: High fat and protein content.



Manchego Chesse:

- PDO
- Exportation: 60%



(PDO Queso Manchego, 2023)

- Quality control of milk based on its **fat, protein, or dry matter content**.
- Hygienic-sanitary control such as **somatic cell count**.

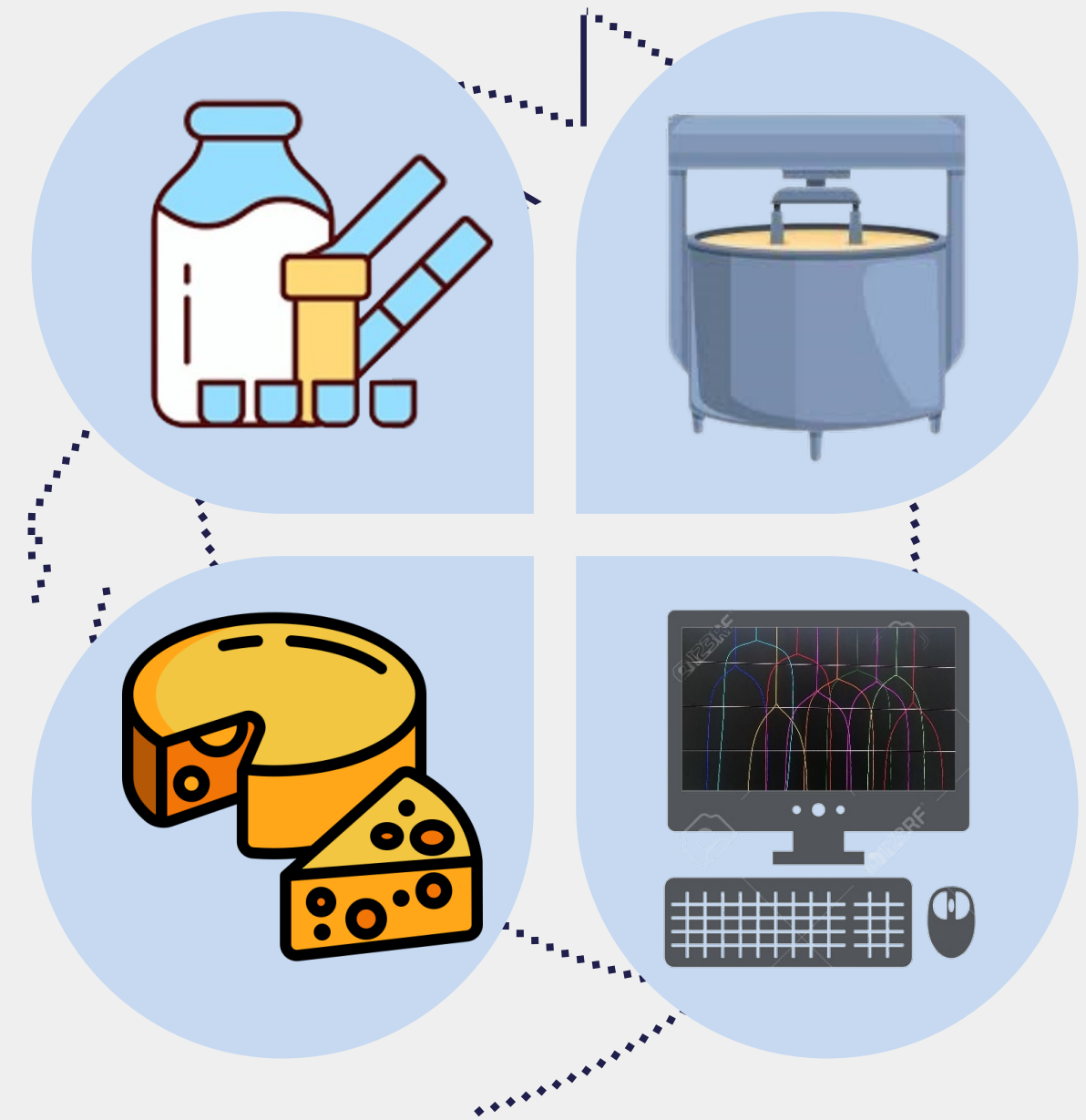


MILK QUALITY

THE AIM OF THIS STUDY

Investigate the effect of SCS in Manchega dairy sheep on:

- milk yield, composition, and color traits
- traditional milk coagulation properties (MCP) traits
- curd-firming model (CF_t) traits
- Cheese-making ability traits.



ANALYZING MILK COMPOSITION AND COLOR TRAITS



Milkoscan: fat (%), protein (%), total solids (%), casein (%), lactose (%), urea (mg/L)



Spectrophotometer: Milk colour (lightness L^* , redness a^* , yellowness b^*).



pH-meter: pH



Fossomatic: Somatic cells count (SCC)

CLASSIFICATION OF SCC

$$\text{SCC} \xrightarrow[\text{transformation}]{\text{Logarithm}} SCS = \log_2 \left(\frac{SCC}{10^5} \right) + 3 \quad (\text{Ali \& Shook., 1980})$$

The milk samples were divided into seven different classes of **half standard deviation**:

Class 1	$SCS < 1.08$
Class 2	$1.08 \leq SCS < 2.34$
Class 3	$2.34 \leq SCS < 3.59$
Class 4	$3.59 \leq SCS < 4.85$
Class 5	$4.85 \leq SCS < 6.11$
Class 6	$6.11 \leq SCS < 7.36$
Class 7	$SCS \geq 7.36$

ANALYZING COAGULATION PROPERTIES TRAITS

Formagraph



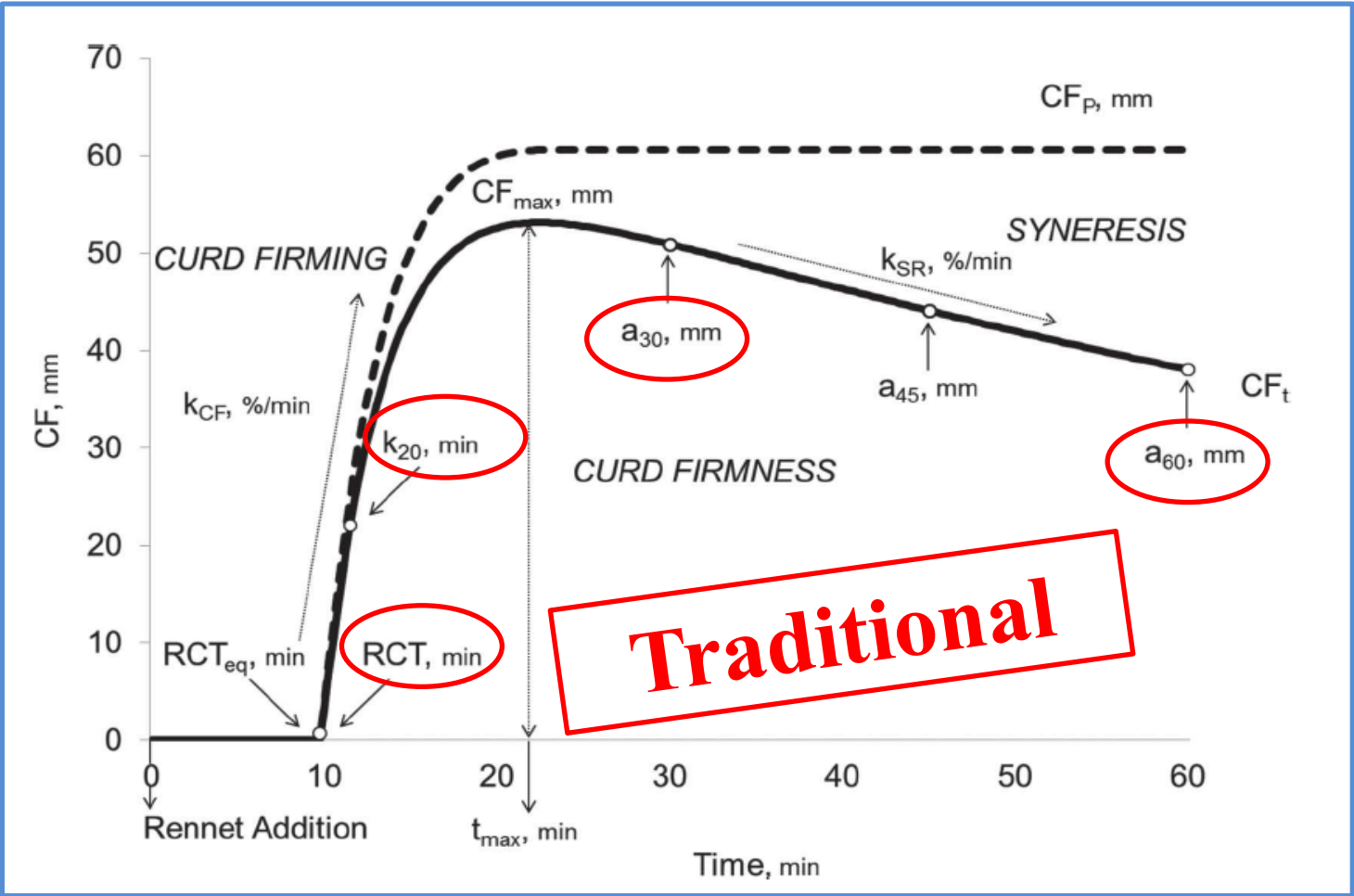
Formagraph



Coagulation curves

ANALYZING TECHNOLOGICAL PROPERTIES TRAITS

Milk coagulation properties (MCP) traits



RCT	Rennet coagulation time	min
K₂₀	Curd-firming time	min
A₃₀	Curd firmness measured at 30 min	mm
A₆₀	Curd firmness measured at 60 min	mm

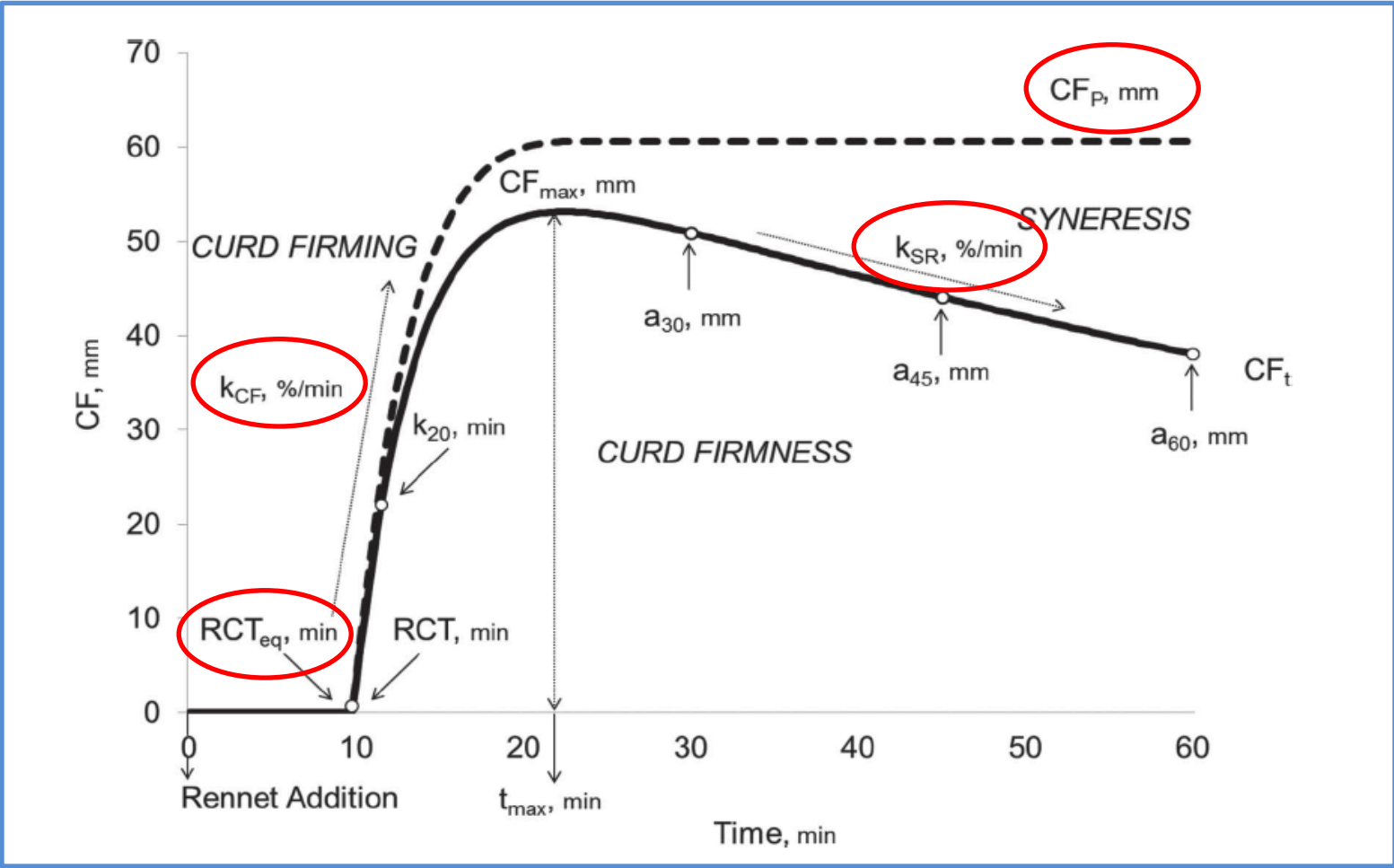
ANALYZING COAGULATION PROPERTIES TRAITS

Curd-firming model (CF_t) traits

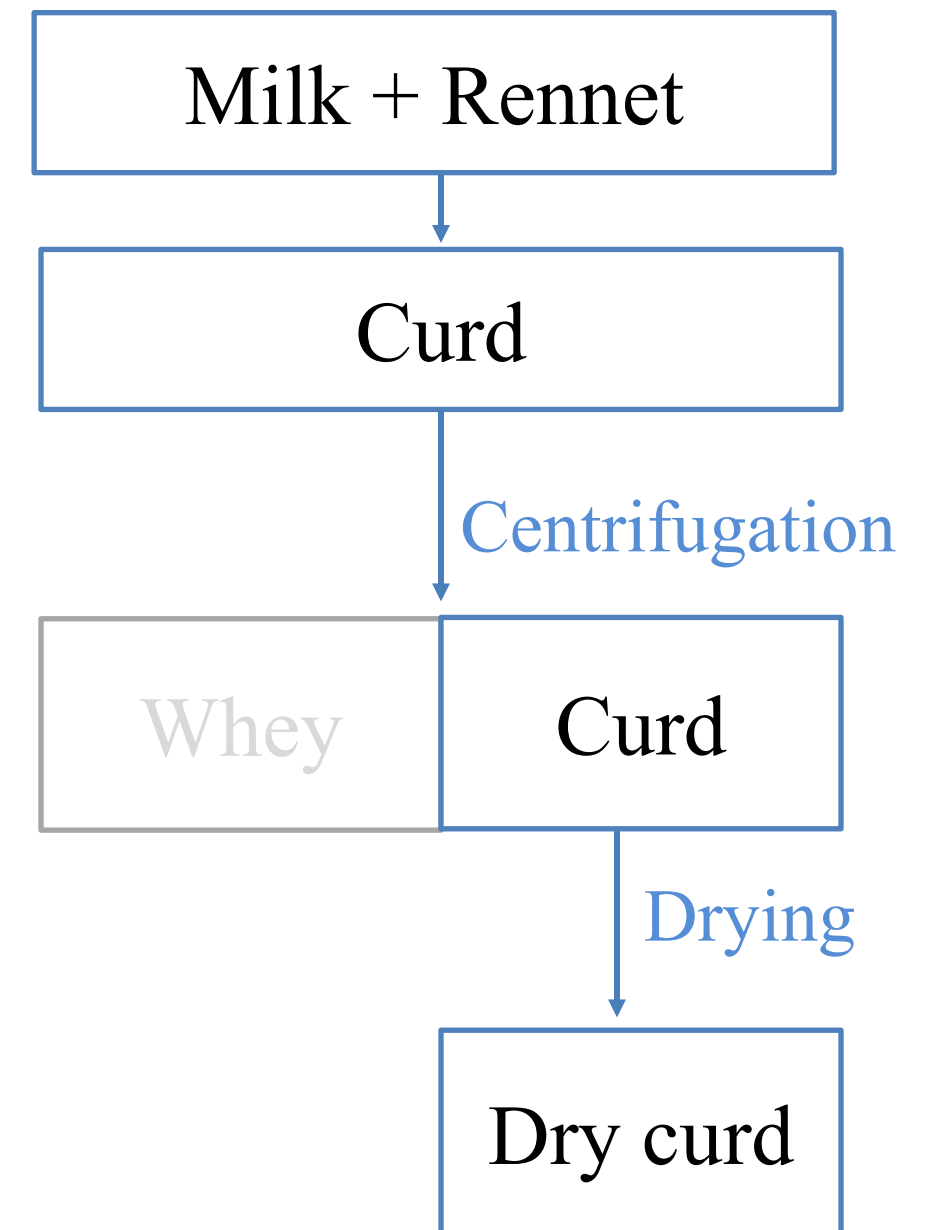
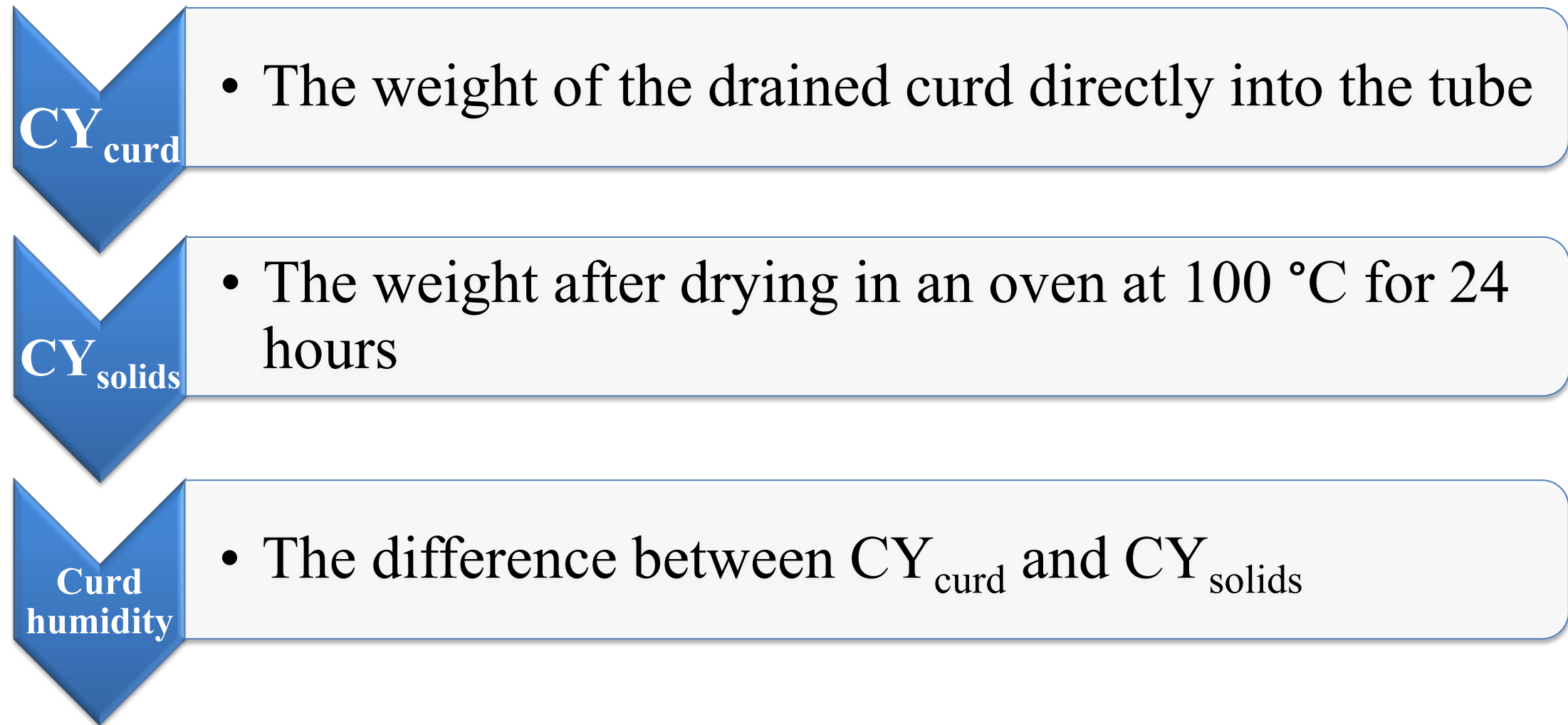
RCT_{eq}	Rennet coagulation time	min
CF_P	Asymptotic potential curd firmness	mm
K_{CF}	Curd firmness instant rate constant	%/min
K_{SR}	Curd syneresis instant rate constant	%/min

$$CF_t = CF_P \times \left[1 \times e^{-K_{CF} \times (t - RCT_{eq})} \right] \times e^{-K_{SR} \times (t - RCT_{eq})}$$

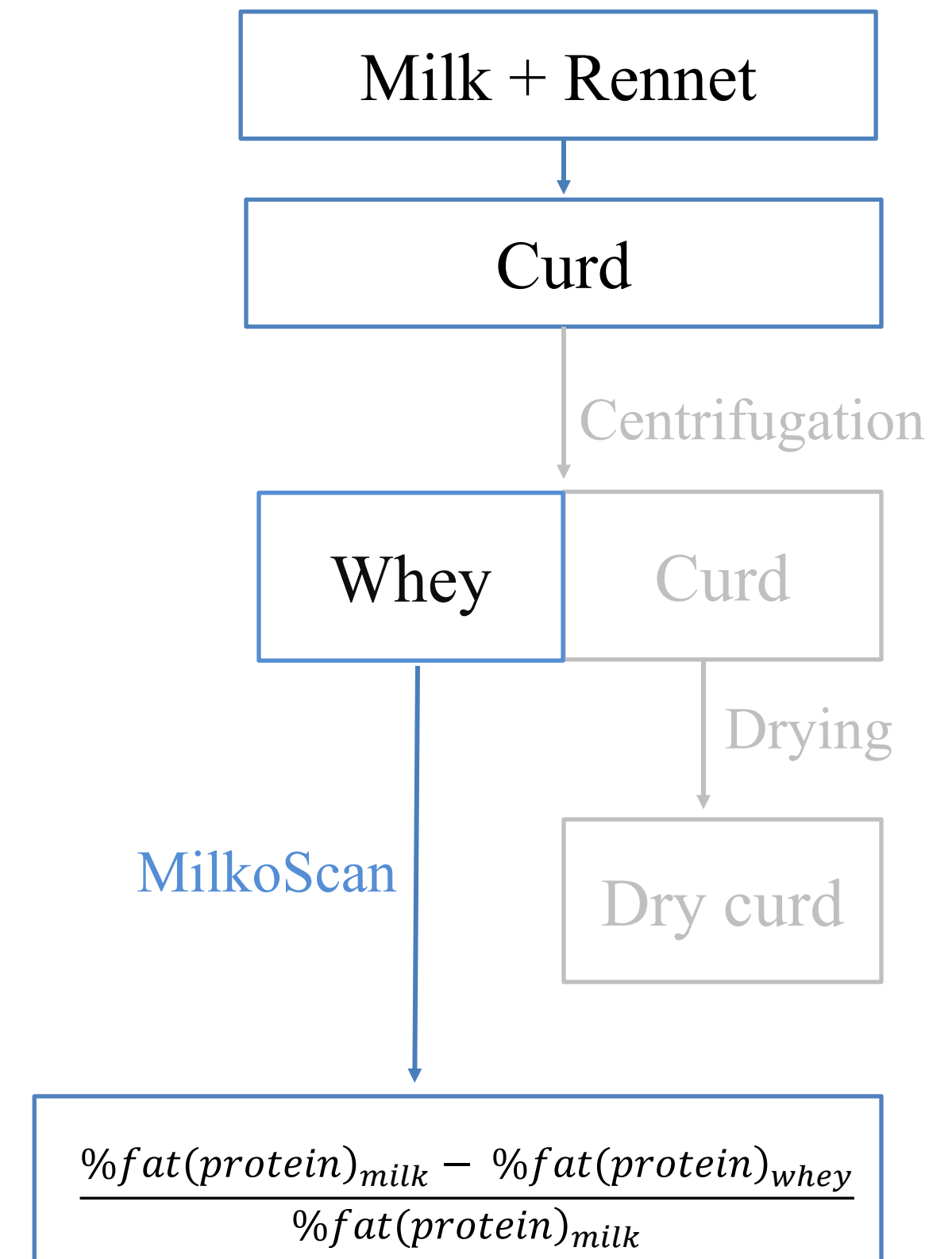
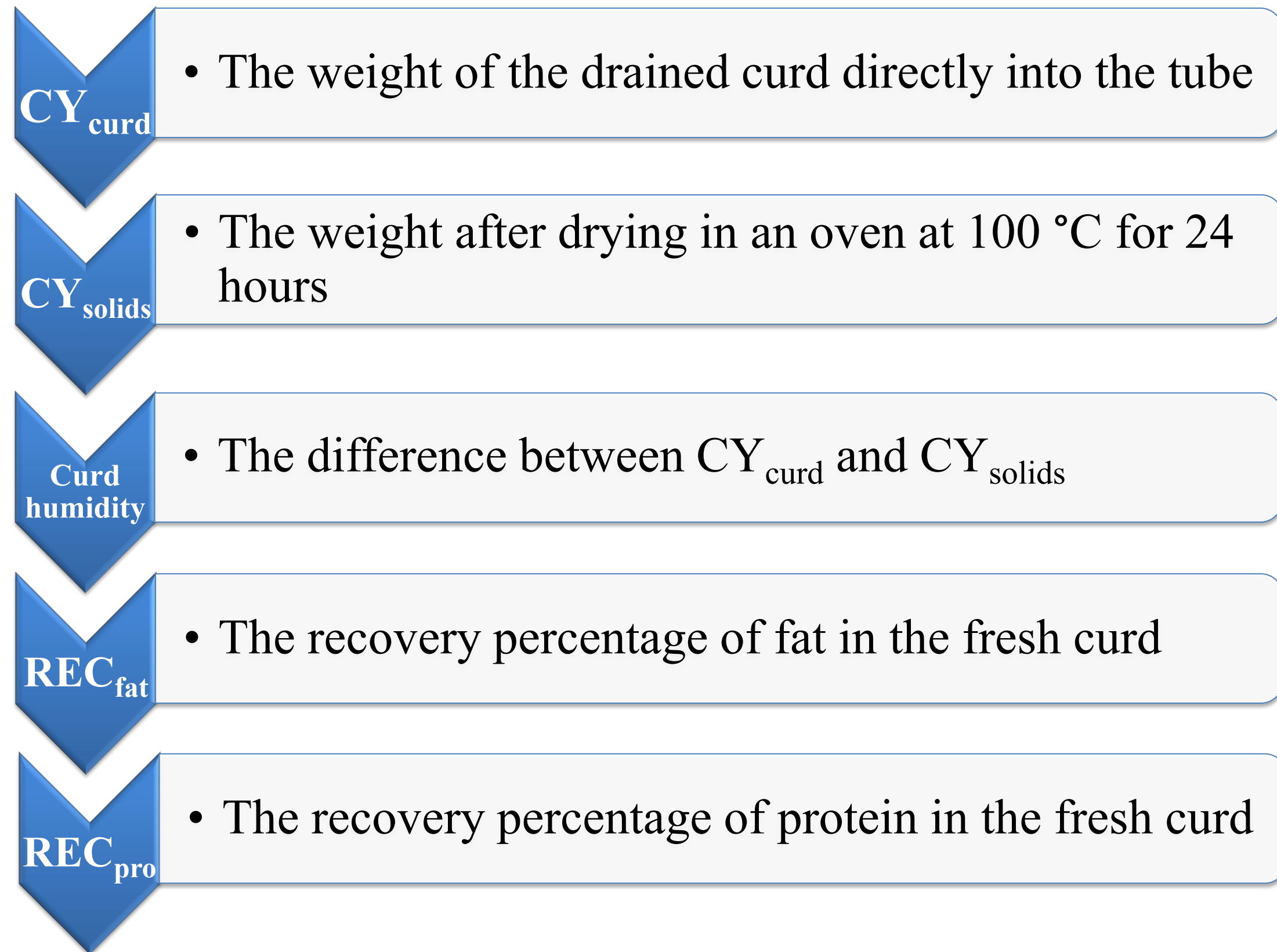
(Bittante et al., 2014)



ANALYZING CHEESE-MAKING ABILITY TRAITS



ANALYZING CHEESE-MAKING ABILITY TRAITS





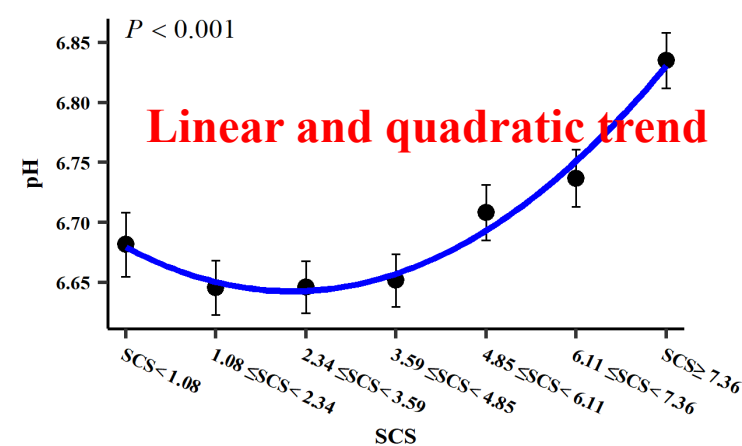
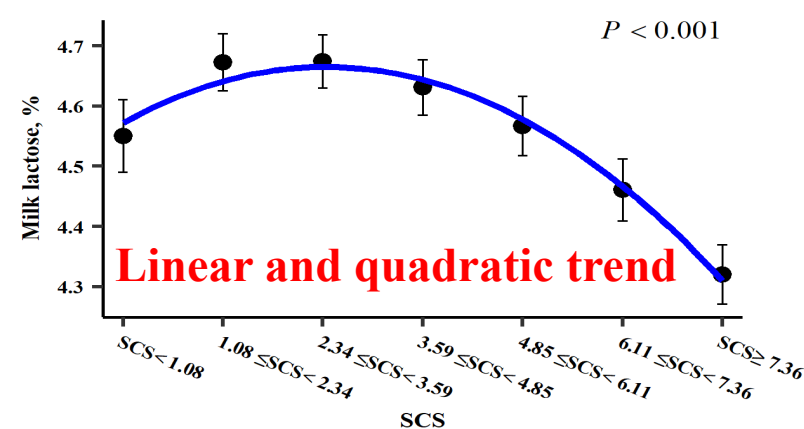
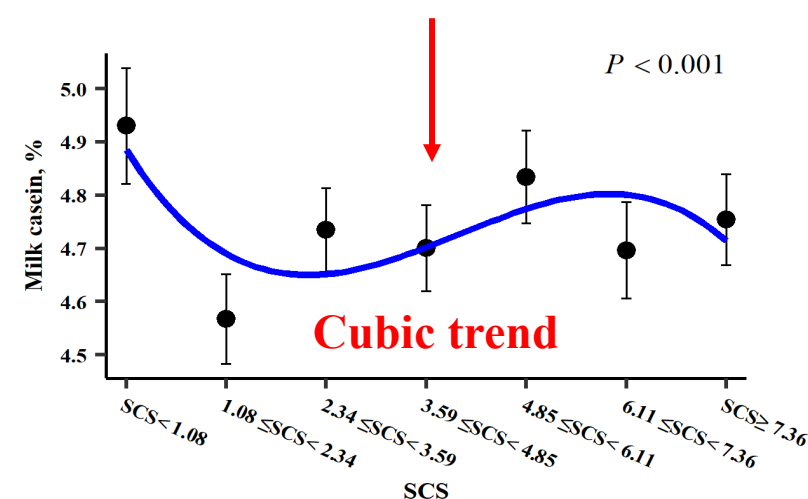
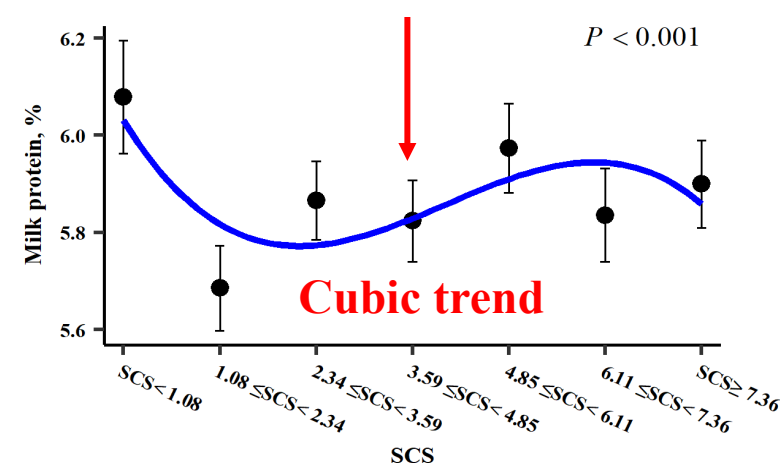
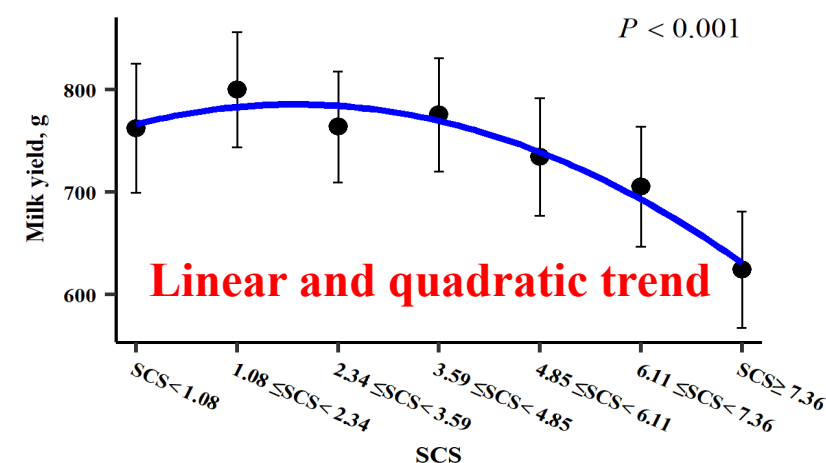
STATISTICAL ANALYSIS

$$y_{ijklm} = \mu + \text{DIM}_i + \text{Parity}_j + \text{Parity type}_k + \text{SCS}_l + \text{Flock-date}_m + e_{ijklm}$$

- DIM_i : Fixed effect of the i th class of days in milk (3 classes)
- Parity_j : Fixed effect of the j th class of parity order (7 classes)
- Parity type_k : Fixed effect of the k th class of parity type (2 classes)
- SCS_l : Fixed effect of the l th class of half standard deviation of SCS, with the fourth class centered on the mean of the trait (7 classes)
- Flock-date_m : Random effect of the m th flock-date record
- e_{ijklm} : Residual random error.

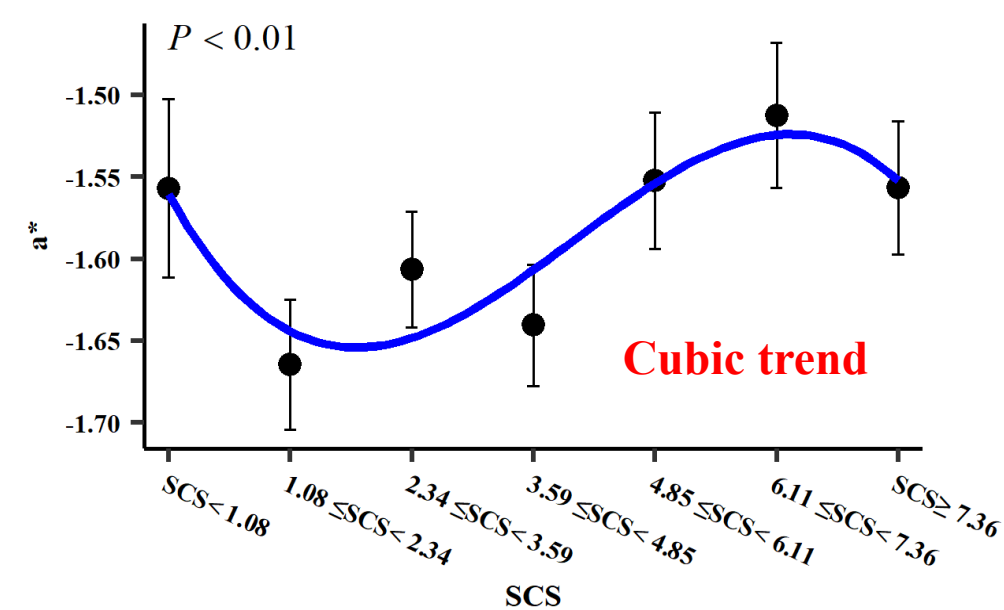
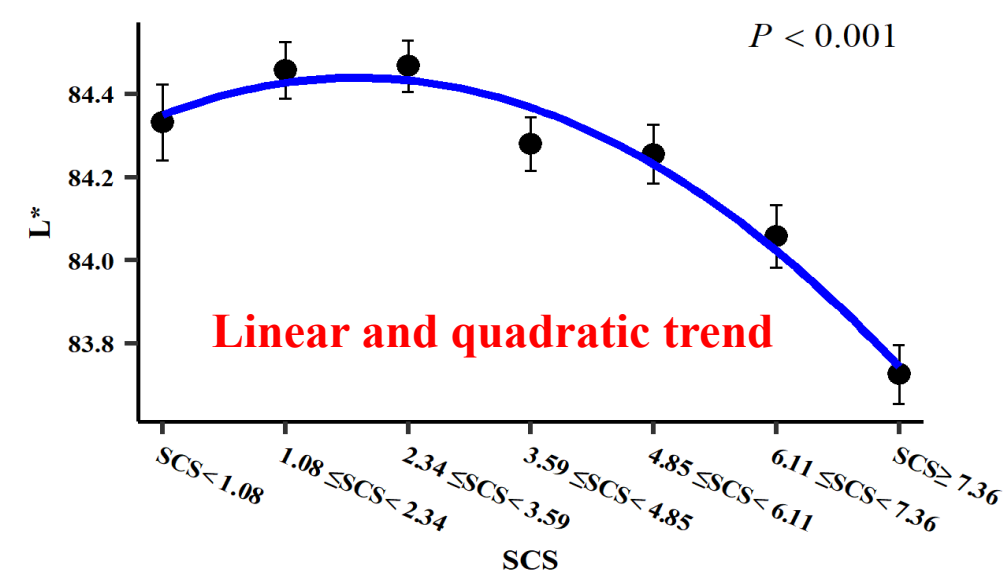
To examine the response curve, polynomial contrasts were estimated, measuring **linear**, **quadratic**, and **cubic** relationships.

SCS EFFECTS ON MILK QUALITY



F-value	
dMY, g	5.89*** ←
Milk composition	
Total solids, %	1.38
Fat, %	1.59
Protein, %	3.82*** ←
Casein, %	4.05*** ←
Casein Index	2.23*
Lactose, %	22.38*** ←
Urea, mg/L	1.39
pH(	38.00*** ←

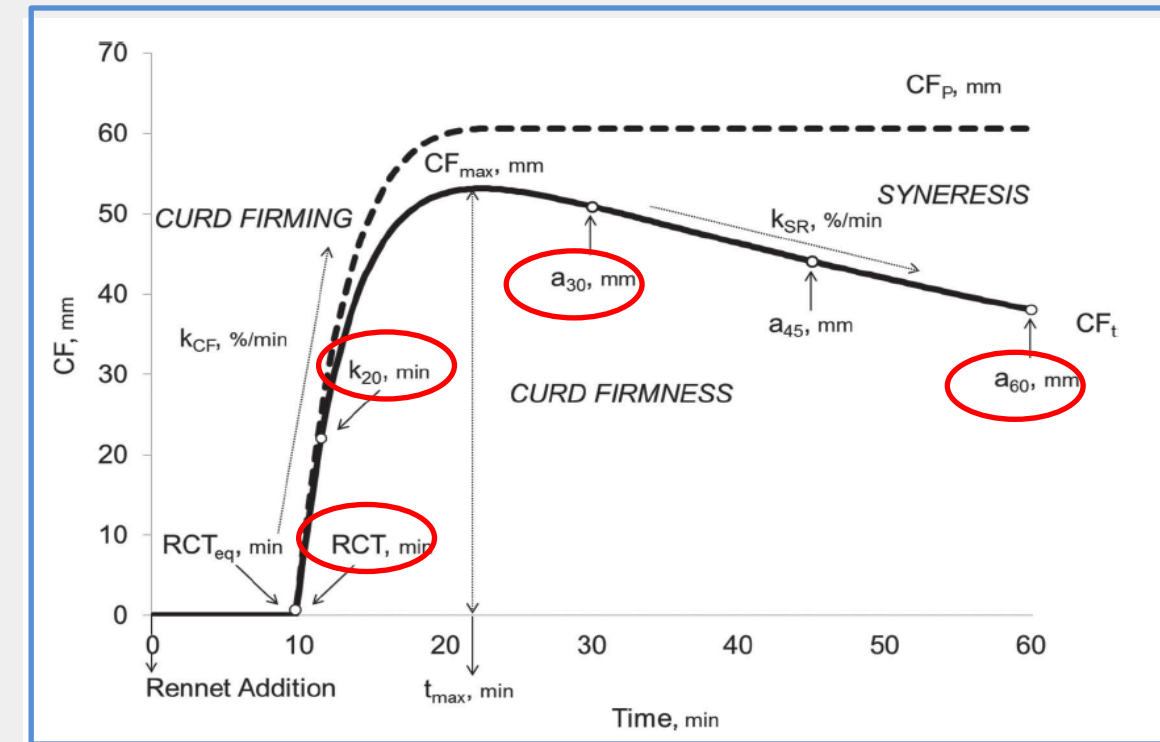
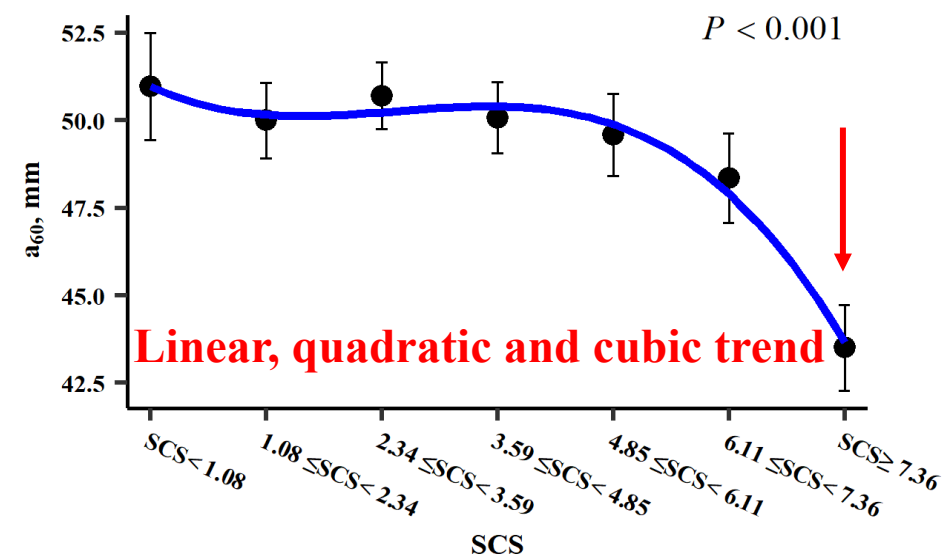
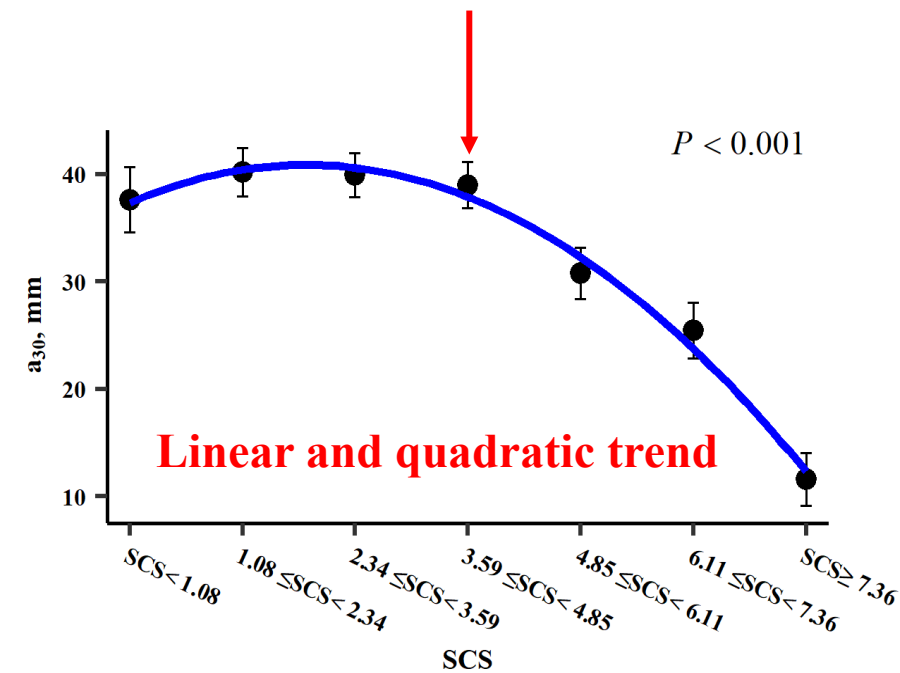
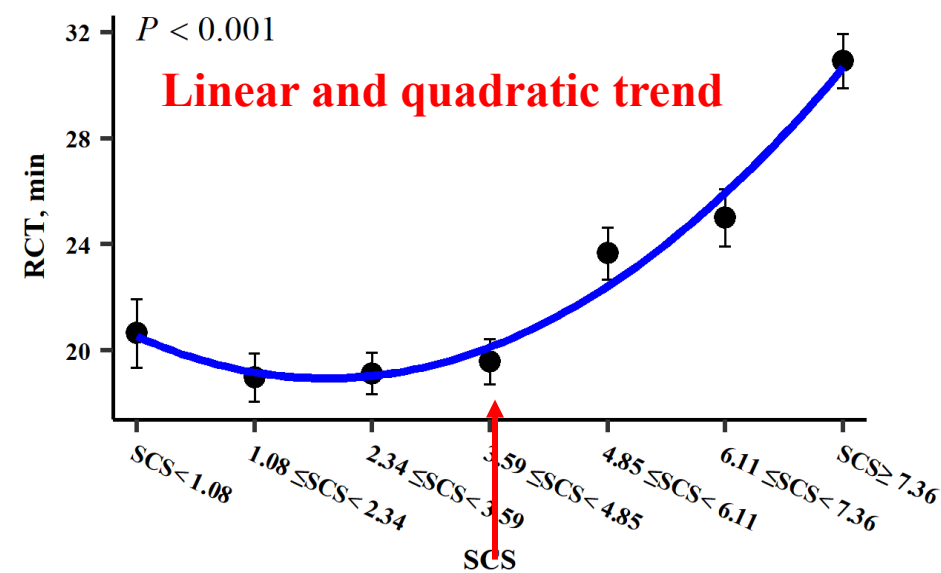
SCS EFFECTS ON MILK COLOUR



F-value	
L*	30.20*** ←
a*	3.42** ←
b*	0.78

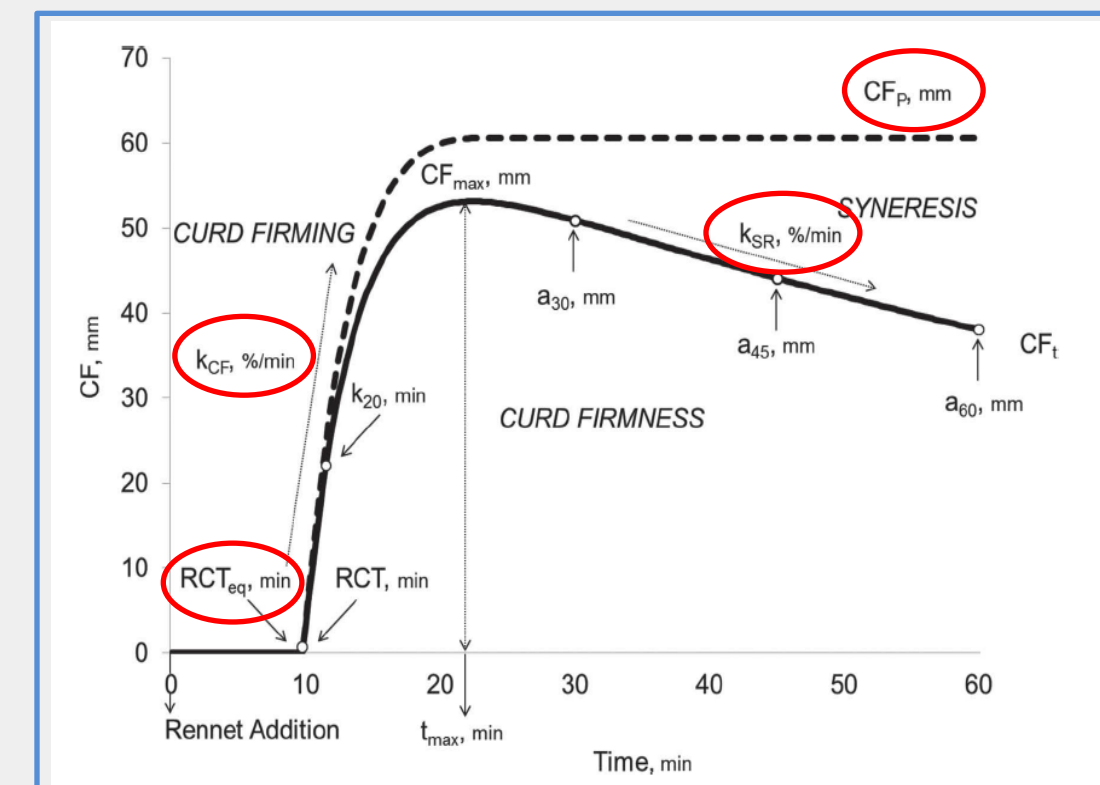
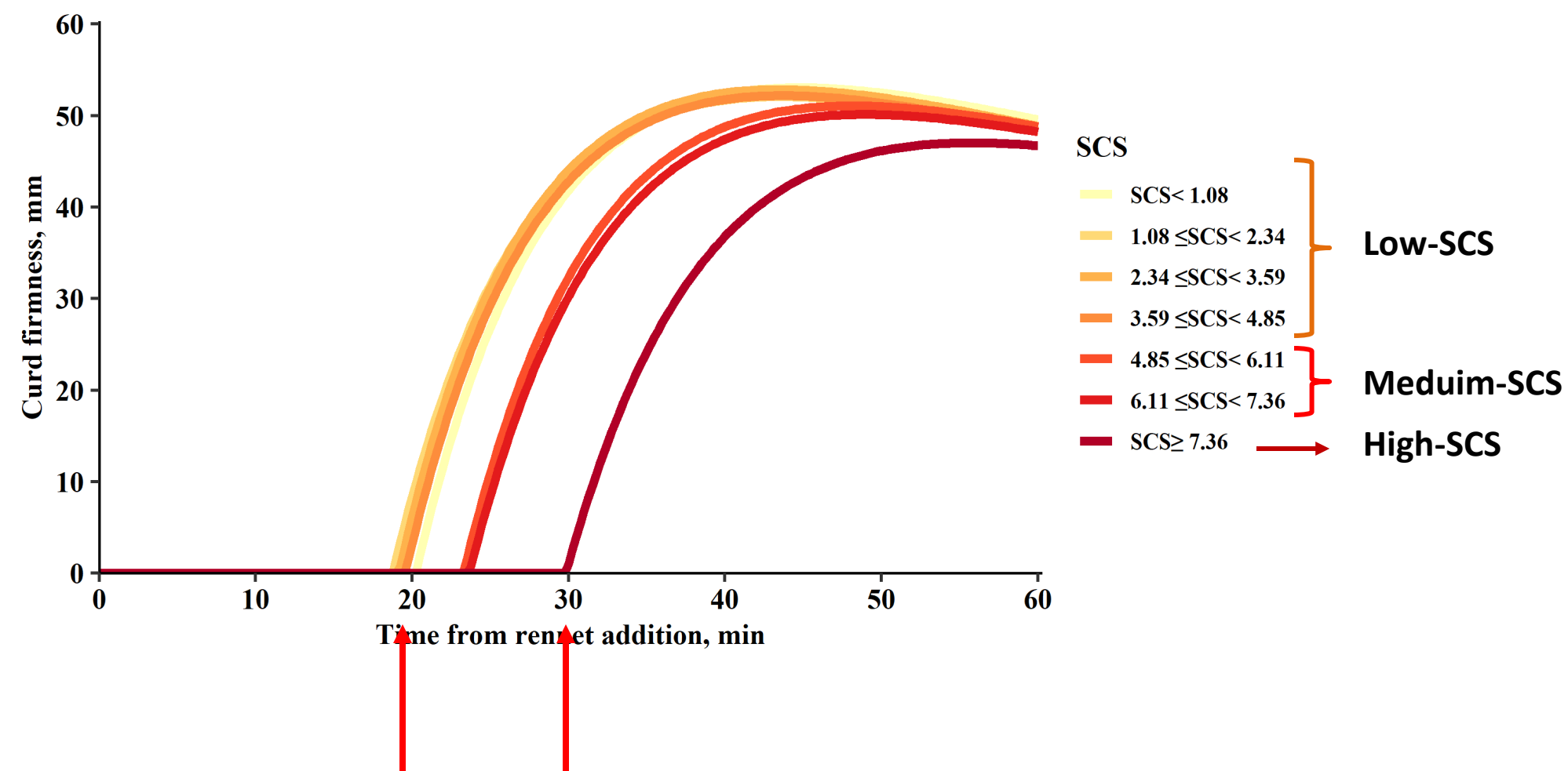
lightness L*, redness a*, yellowness b*

SCS EFFECTS ON MCP



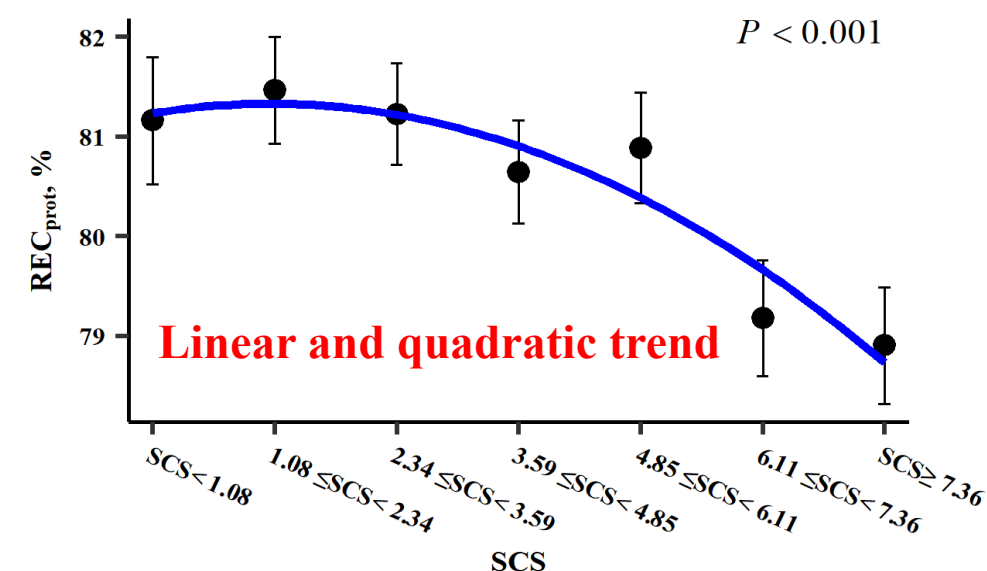
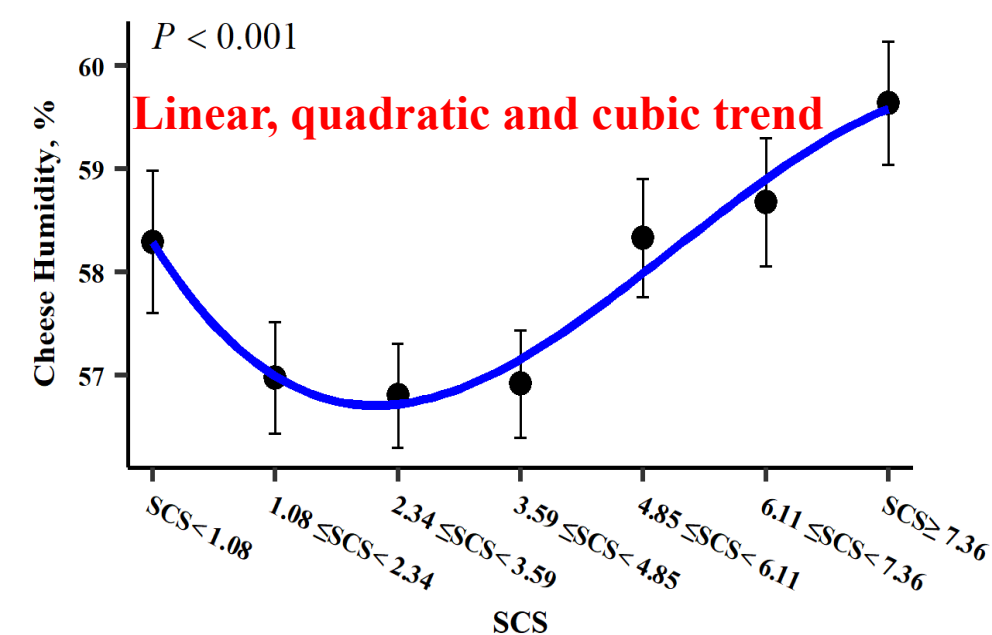
F-value		
RCT, min	31.35***	←
k_{20} , min	3.77**	←
A_{30} , mm	39.60***	←
A_{60} , mm	7.53***	←

SCS EFFECTS ON CF_t



F-value	
RCT_{eq} , min	27.85*** ←
k_{CF} , %/min	2.64*
k_{SR} , %/min	1.17
CF_p , mm	14.97*** ←

SCS EFFECTS ON CHEESE-MAKING ABILITY TRAITS



	F-value
CY _{curd} , %	2.02
CY _{solids} , %	0.86
CH, %	9.69*** ←
REC _{protein} , %	10.25*** ←
REC _{fat} , %	0.74

CONCLUSIONS

- The SCS has a strong effect on the majority of investigated traits: Compromising the milk quality, delaying the coagulation, weakening the curd firmness also affecting cheese-making efficiency.
- SCS affected the coagulation properties and cheese-making efficiency either directly, or indirectly through changes in milk components and other factors.
- The notable SCS effect on technological properties was observed at **4.85 log₂cell/ml (360,000 cells/ml)**, setting it as the advisable limit to ensure good milk coagulation.

THANK
YOU

PROYECTO PID2020-118031RR-C21: ESTUDIO DE LA VARIABILIDAD INDIVIDUAL DE LAS PROPIEDADES TECNOLÓGICAS DE LA LECHE DE OVEJA PARA SU IMPLEMENTACIÓN EN PROGRAMAS DE CRÍA (REFERENCIA DEL PROYECTO/AEI/10.13039/501100011033)



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