

Contribution to study of rennet used in the elaboration of Flor de Guía cheese.

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INTRODUCTION

Flor de Guía Cheese (PDO) is produced with vegetal rennet at cheese farms on the island of Gran Canaria, Spain. This PDO's cheese includes two fundamental requirements:
 -the exclusive use of vegetable rennet as a milk coagulant (*Cynara cardunculus* var. *ferocissima* or *Cynara scolymus*),
 - certain percentages in the milk used according to the species of origin ($\geq 60\%$ sheep milk, $\leq 40\%$ cow milk and $\leq 10\%$ goat milk).
 These two variables, depending on the random criterion of the cheese-maker, give us the interest of knowing the possible influence they may have on the production process and on the variability of the final characteristics of the cheese.

Objectives: to observe the influence of the use of:
 -different concentrations of thistle on the coagulation of different types of milk and
 -different mixtures of milk from different species on the clotting time and the final characteristics of the product.



Maceration of thistle extract



Filtration of thistle extract



Tubes with milk and thistle extract



METHOD

The tests for the coagulant activity were carried out following the Berridge technique modified by the NOVO method, obtaining the enzymatic solution from dried thistle flowers in maceration, provided by a cheesemaker and tested on reconstituted milk.
 The solutions of thistle extract were prepared at 5 different concentrations (1%-5%) in distilled water.
 The test was completed with a combination of the three kinds (sheep, cow, goat) of milk in different ranges (Table 1) and with a concentration of thistle extract at 1%.

Table 1. Each treatment corresponds with a combination of the three kinds of milk.

	Treatment								
	1	2	3	4	5	6	7	8	9
Sheep	60	60	70	70	80	80	90	90	100
Cow	30	40	20	30	10	20	0	10	0
Goat	10	0	10	0	10	0	10	0	0

Data are %

STATISTIC ANALYSIS

Multivariate linear analysis was applied with the variables: % Sheep, % Cow and binary variable with value one when % Sheep = 100 and zero otherwise ($I(\% \text{Sheep}=100)$).
 Selection of variables: regression and Bayesian Information Criterion (BIC).
 Estimated model was summarized as coefficients, standard errors (SE) and p-values.
 Goodness of fit: adjusted R-square (values between 0 and 1)
 Statistical significance was set a $p < 0.05$
 Data analyze: R package, version 3.1.1.

RESULTS

The thistle extract presents a greater clotting activity when its concentration increases (Figure 1). This effect becomes more evident in low concentrations of vegetable rennet used on sheep's milk, followed by cow's milk (Figure 2).

Based on the graphic exploration of the obtained data, a linear model was proposed for the variable "clotting time", depending on the percentage of sheep's milk used, with a correction for the concentration of 100% sheep's milk.
 The selected model has the form:
 $\text{Clotting time} = \beta_0 + \beta_1 \cdot \% \text{Sheep} + \beta_2 \cdot I(\% \text{Sheep} = 100) + e$
 being 1 or 0 according to $\% \text{Sheep} = 100$ or not and the error term.

As the percentage of sheep increases in any milk mixtures of different species (PDO), the coagulation is accelerated by the vegetable rennet extract (Table 2).

Table 2. Estimation of the linear model for the clotting time.

	Coefficient (SE)	P-value	Adjusted R ²
(β_0)	7.758 (0.430)	< 0.001	0.636
$\% \text{Sheep} (\beta_1)$	-0.050 (0.006)	< 0.001	
$I(\% \text{Sheep} = 100) (\beta_2)$	1.461 (0.237)	< 0.001	

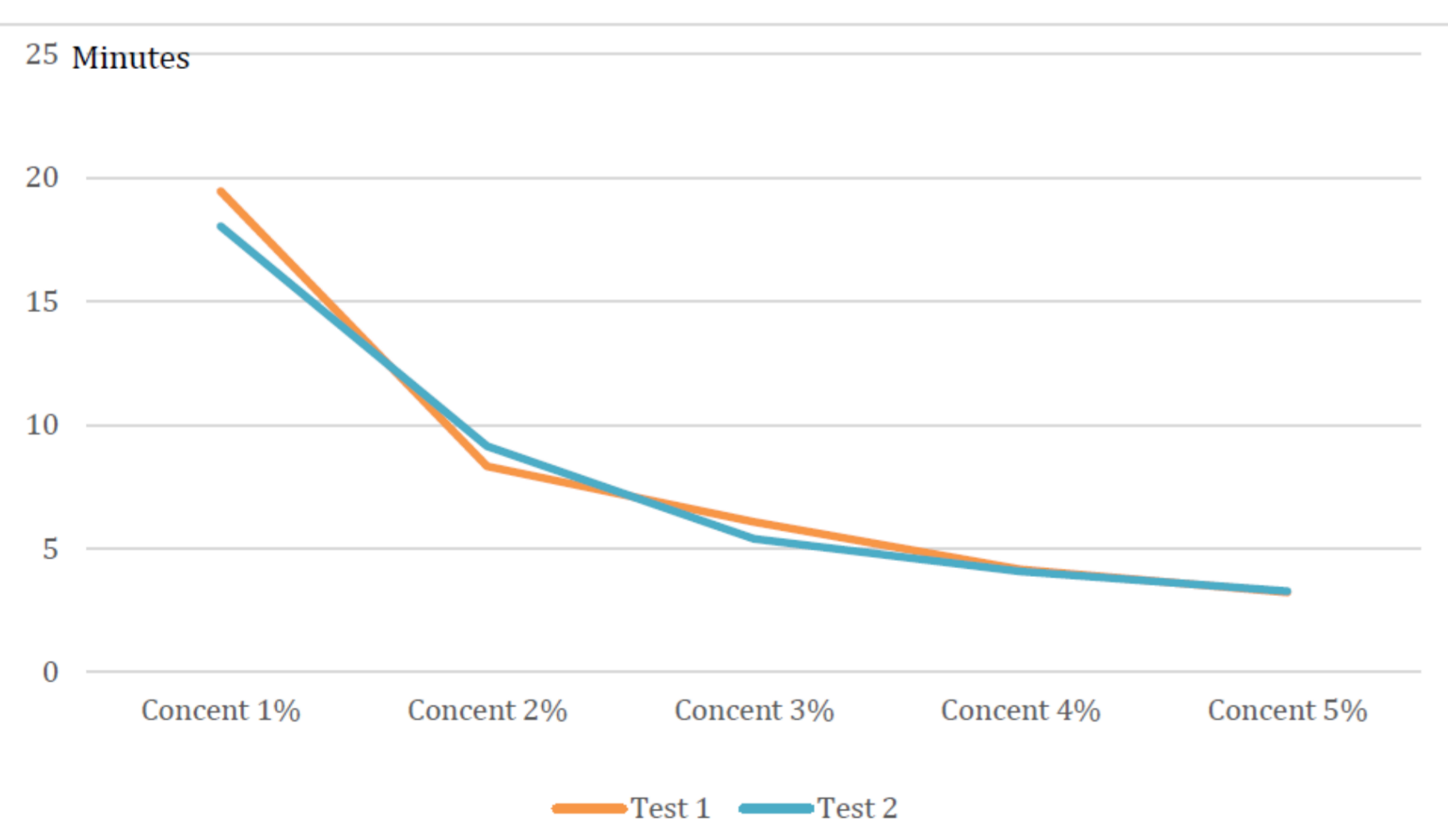


Figure 1. Clotting activity (minutes) of different concentrations of thistle in reconstituted milk.

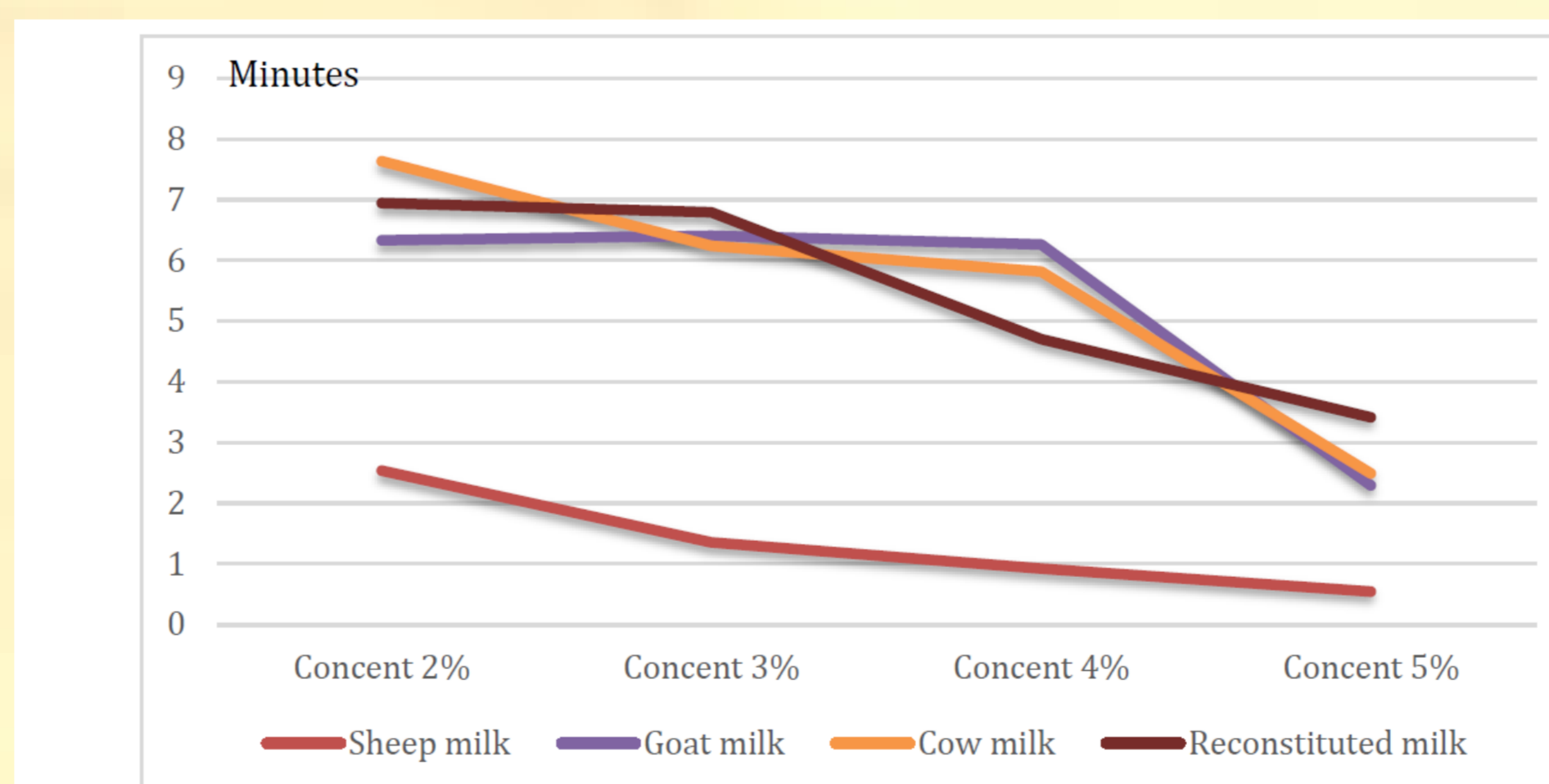


Figure 2. Clotting time (minutes) with different percentages (%) of thistle extract in different types of milk.

The increase of thistle concentration and percentages of sheep's milk, contributes to acceleration in the coagulant activity, which is estimated in a greater creaminess, viscosity and acceptability of cheeses, but also in excess, in the appearance of bitter tastes, acids and texture defects.

Good practice by the cheese-makers assigned to the PDO may be the combined use of high percentages of sheep's milk, but using thistle extracts with moderate strength. In this way, cheeses with pleasant sensory characteristics can be obtained, avoiding the appearance of defects that would depreciate their value.

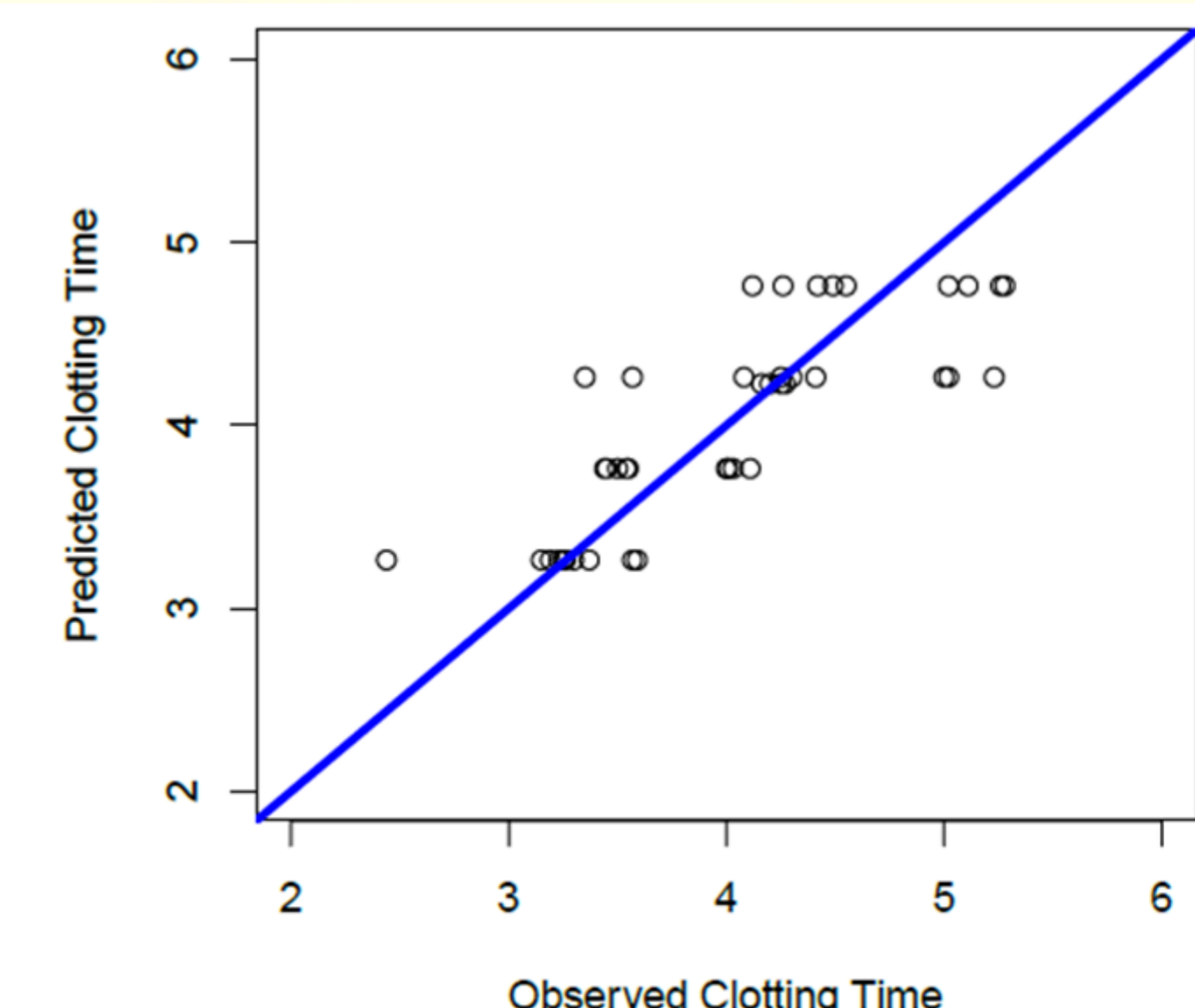


Figure 3. Predicted clotting time versus observed clotting time. The line is the bisector of the first quadrant. The proximity of the points to the line indicates a good fit.