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A laboratory micro-manufacturing method for assessing individual cheese yield

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ABSTRACT – This study aimed to propose a micro-manufacturing method for assessing individual cheese yield (CY) from dairy milk and to provide first evaluations of the method. Two water baths (WB) provided with 8 stainless containers (SC) each were used. The cheese making procedure involved coagulation of 500 ml of milk per SC previously inoculated with starter, cutting of the curd, separation of whey through drainage and pressure and weighing of the curd residue for computing CY. Spray-dried milk powder and bulk milk were used to validate the procedure. For each type of milk, 5 cheese making sessions (CMS) were performed during 5 consecutive days by the same operator; for each trial 80 records (8 replicates x 2WB x 5CMS) were available. Sources of variation of CY were investigated separately for type of milk, and variance components were estimated using REML procedure for computing instrumental repeatability and reproducibility. Cheese yield averaged 11% and 13.4% for standard milk powder and bulk milk, respectively. Cheese making session significantly influenced CY, along with WB in the case of milk powder, while SC did not influence CY. Reproducible and repeatable measures of CY were obtained, indicating the method is suitable for assessing individual CY.

Key words: Dairy milk, Cheese yield, Repeatability, Reproducibility.

Introduction – Milk coagulation properties play a fundamental role in the cheese making process, especially in countries such as Italy where the majority of milk is used to produce high quality cheeses and the dairy industry is of great economic relevance. Therefore, in recent years several studies have been conducted to investigate procedures useful for predicting technological properties of milk to be used on large-scale milk recording programmes and for assessing the genetic selection for them in dairy cattle (Cassandro *et al.*, 2008; Dal Zotto *et al.*, 2008; De Marchi *et al.*, 2009). Cheese yield, defined as the weight of cheese obtained from a given weight of milk, is a major factor affecting profitability of cheese production (Emmons, 1993). Cheese yield is influenced by milk characteristics (Mercanti *et al.*, 2008), and procedures able to give reliable assessment of individual cheese yield, could be of great interest for breeding purposes. This study investigated a laboratory micro-manufacturing method for assessing individual cheese yield from dairy milk and to provide preliminary evaluations of the method.

Material and methods – The micro-manufacturing method consisted of 2 water baths, each provided with a thermostat pump for milk heating and temperature regulation during cheese-making; in each water bath 8 stainless containers (SC) were used for processing 500ml of milk each. The validation of the procedure was carried out using 2 types of milk: in the first trial a spray-dried milk powder certified for milk-clotting tests (Lactalis Industrie France, ETS BBA) and reconstituted as 111 g/l according to the procedures defined by FIL-IDF (1996) was used; in the second trial milk samples collected during 5 consecutive days from the same 4 Holstein Friesian cows and immediately mixed to obtain bulk milk were used. For each type of milk 5 cheese making sessions were performed across

5 consecutive days by the same operator, and for each cheese making session 8 replicates (i.e. the stainless containers) per water bath were obtained. The potential number of records per trial was 80 (8 replicates x 2 water bath x 5 cheese making sessions), but only 79 were available due to accidental loss of samples during cheese making. Several steps were followed during the cheese making process: 500ml of milk were dispensed in each container and dipped into the water bath previously warmed at 35°C. After 30' each container was inoculated with 8 units of starter (DELVO-TEC TS-10A DSL, DSM), and after 90' 0.16 ml of calf rennet (NATUREN TM STANDARD160) diluted 20-fold in distilled water was added. The coagulation process took place and after 10' of firming time the curd was cut with double longitudinal crosses. After 5' of rest the curd was spilled on a metal sieve, turned over the metal sieve after 30' and topped with 1kg weight for 18 hours. The resulting curd was weighed and cheese yield (CY) was computed as the ratio between weight of curd obtained and weight of milk initially dispensed in each container. Sources of variation of cheese yield were investigated separately for type of milk according to a linear model which considered the fixed effects of cheese making sessions (CMS), water baths (WB), CMSxWB and SC nested within WB. Variance components were estimated through REML procedure, separately for type of milk, according to a linear model where the random effects of CMS, WB and CMSxWB were included. Reproducibility (RD), defined as the value below which the absolute difference between two single measures obtained on the same milk sample under different conditions (different water baths) is expected to lie with a probability of 95% (International Organization for Standardization, 1994a, b) was computed according to the following functions of estimated variance components: $RD = 2 \cdot \sqrt{2 \cdot (\sigma^2_{WB} + \sigma^2_{WBxCMS} + \sigma^2_e)}$. Repeatability (RT), defined as the value below which the absolute difference between two single measures obtained on the same milk sample under the same conditions is expected to lie with a probability of 95% (International Organization for Standardization, 1994) was computed according to the following functions of estimated variance components: $RT = 2 \cdot \sqrt{2 \cdot \sigma^2_e}$.

Results and conclusions – Descriptive statistics for cheese yield (CY) are summarized in Table 1. Cheese yield averaged 11% and 13.4% for standard milk powder and bulk milk, respectively. Variation observed was slightly different in the 2 types of milk, and CV did not exceed 6%.

Only CMS consistently influenced CY (Table 2). In this study CMS accounts for random variation due to date of processing, differences in reconstitution of milk powder and differences in milk samples collected from the same cows in different days. Water bath significantly affected CY only when milk powder was processed, while SC did not influenced CY, indicating there is no effect of position of container within WB.

On the whole, absolute differences among CY obtained from different containers or water baths were very small: for bulk milk the maximum difference approached 0.37 and 0.14 for container and water bath, respectively (Table 3), which corresponds to 3% and 1% of the average of CY, respectively. Repeatability of CY ranged between 1.07 and 0.80 for milk powder and bulk milk, respectively, and repro-

Table 1. Descriptive statistics for cheese yield (%).

	N.	Mean	Sd	CV[1], %	Min	Max
milk powder	79	11.07	0.42	3.8	10.00	12.25
bulk milk	79	13.39	0.76	5.7	11.64	14.91

[1]*Coefficient of variation.*

Table 2. Sources of variation (P value) and mean square error (MSE) for cheese yield.

Sources of variation	df	milk powder	bulk milk
Cheese making session (CMS)	4	**	**
Water bath (WB)	1	**	Ns
CMS x WB	4	Ns	Ns
Stainless container(WB)	14	Ns	Ns
MSE	55	0.157	0.076

***=P<0.01; Ns=not significant.*

ducibility was slightly higher (Table 3). Therefore, the variation in CY due to experimental procedures did not exceed 6% of the average CY when bulk milk was processed. In conclusion, the micro-manufacturing method described in this study seems to be suitable for the assessment of cheese yield from a small volume of dairy milk, and could be proposed in large-sample studies to investigate CY at individual level. Results from these preliminary evaluations indicate that variation in CY in the procedure proposed is low, particularly when bulk milk is processed. Estimates of instrumental repeatability and reproducibility were favourable and this promotes further research on the accuracy of the method proposed (*i.e.* the relationship between cheese yield assessed with the micro-manufacturing method and current cheese yield at industrial level), to study individual variation in cheese yield to highlight genetic aspects and to relate traits usually adopted for predicting processing ability of milk, such as milk coagulation properties, with a real assessment of CY.

Table 3. Observed maximum differences between LS means of cheese yield obtained in different stainless container (SC) and water baths (WB) and instrumental repeatability (RT) and reproducibility (RD) of measures provided by micro-manufacturing method.

	maximum differences obtained in different:		RT	RD
	SC	WB		
milk powder	0.53	0.25	1.07	1.12
bulk milk	0.37	0.14	0.80	0.84

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REFERENCES – **Cassandro**, M., Comin, A., Ojala, M., Dal Zotto, R., De Marchi, M., Gallo, L., Carnier, P., Bittante, G., 2008. Genetic parameters of milk coagulation properties and their relationships with milk yield and quality traits in Italian Holstein cows. J. Dairy Sci., 91:371-376. **Dal Zotto,** R., De Marchi, M., Cecchinato, A., Penasa, M., Cassandro, M., Carnier, P., Gallo, L., Bittante, G., 2008. Reproducibility and repeatability of measures of milk coagulation properties and predictive ability of mid-infrared reflectance spectroscopy. J. Dairy Sci., 91:4103-4112. **De Marchi,** M., Fagan, C.C., O'Donnell, C.P., Cecchinato, A., Dal Zotto, R., Cassandro, M., Penasa, M., Bittante, G., 2009. Prediction of coagulation properties, titrable acidity, and pH of bovine milk using mid-infrared spectroscopy. J. Dairy Sci., 92:423-432. **Emmons,** D.B., 1993. Definition and expression of cheese yield. In: Factors affecting the yield of cheese. International Dairy Federation monogr. Special issue 9301, pp. 12-20. Brussel: International dairy Federation. **FIL-IDF**, 1996. Norma 176. **International Organization for Standardization**, 1994a. Accuracy (trueness and precision) of measurement methods and results - Part 1: General principles and definitions. ISO 5725-1. International Organization for Standardization, Geneva, Switzerland. **International Organization for Standardization,** 1994b. Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method. ISO 5725-2. International Organization for Standardization, Geneva, Switzerland. **Mercanti,** D.J., Busetti, M.R., Meinardi, C.A., Zalazar, C.A., 2008. Studies on a fast method for determining the yield in the production of Argentinean sheep cheeses. Food Chemistry, 107:1717-1723.