Camel gruyere cheese making

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Introduction. The particularity of camel milk is its low quantity of k-caseins, only around 3% compared to cow milk 13% (Farah, 1993). Traditionally processing of camel milk is only under fermented liquid products. However after several research studies on technological aspect it is possible now to get camel cheese. Some authors describe already some technologies to get soft and hard type of cheese (Ramet, 1985). Nevertheless the variety of available cheese from camel milk is quite limited. Most of the researches were focused on the origin of chymosin to improve the clotting power rather than to adapted technologies for increasing the variability of final products. The objectives of the present paper are (i) to get camel cheese type gruyere (cooked or not) and (ii) to control microbiological safety.

Material and methods. *Ingredients*. Camel milk was sampling from healthy dromedary camels from Camel and Range Research Center, Al-Jouf, KSA at mid of lactation stage. For clotting camel milk specific chymosin for camel milk (ChyMax Hansen©, Denmark) was used. To get cheese type gruyere, specific ferments comprising Lactobacillus helveticus and Lactobacillus lactis (Coquard ™, France) was used.

Processing. Two trials were achieved using 5 and 10 L of camel milk, but the procedure was the same. Gruyere ferments were added in whole camel milk at ambient temperature, and then incubated for 1 hour. Camel chymosin was added for clotting (for 1-2 h) and then the clot was cut in cube of 1 cm^3. After incubation for 1.5 hour the clot was heat (at 55^oC for 40-45 minutes) or not. Then hand-filling was proceeding into cloths; for a first draining for 15 minutes, and a second one in moulds for 4-24 h. After draining the pressed cheese (375 kg per m^2) was put in brine (10-20%) for 0.5-10 hours. Ripening of cheese was achieved in two steps: for 2-3 weeks at 10-14^oC and 2-4 weeks more at 24-26^oC.

*Microbiological contro*l analysis was achieved according to the standards: 9225-84. «Milk and milk products. Microbiological method of analysis», 30347-97 «Milk and milk products. Method of determination of *Staphylococcus aureus*», 10444.11-91 "Food products. Method of detection of lactic microorganisms". By using those standard, mesophilic aerobe and anaerobe facultative bacteria, coliforms, pathogen *Staphylococcus aureus* and lactic bacteria were quantified.

Results and discussion. *Obtained cheese.* Finally, ten cheeses were prepared, six from 5 liters camel milk and 4 from 10 liters. Half of the cheeses in both groups were cooked (n= 5) and the others non-cooked (n=5). The yield was an average in 6.3 ± 1.3% with slight variability according to cooked or non-cooked status and according to processed milk quantity (Table 1).

Table 1. Cheese yield according to quantity of processed camel milk and cooking status

Type of cheese	From 5 L	From 10 L	Total
Cooked	7.3 ± 0.9	5.0 ± 0.5	6.4 ± 1.4
Non-cooked	6.9 ± 0.3	4.9 ± 0.8	6.1 ± 1.2
Total	7.1 ± 0.7	4.9 ± 0.5	6.3 ± 1.3

The higher yield in small quantity of processed camel milk is mainly due to the duration of ripening time. Texture (crumbly or firm), color (white to yellow) and taste (more or less salty) varied according to different parameters (quantity of processed milk) cooking status, duration of brining and/or ripening (Photos 1).

Microbiological results. Regarding microbiological status no pathogen microflora was detected, except very small quantity of *St.aureus* in two cheeses (Table 2). The presence of pathogen bacteria could be attributed to post processing contamination.

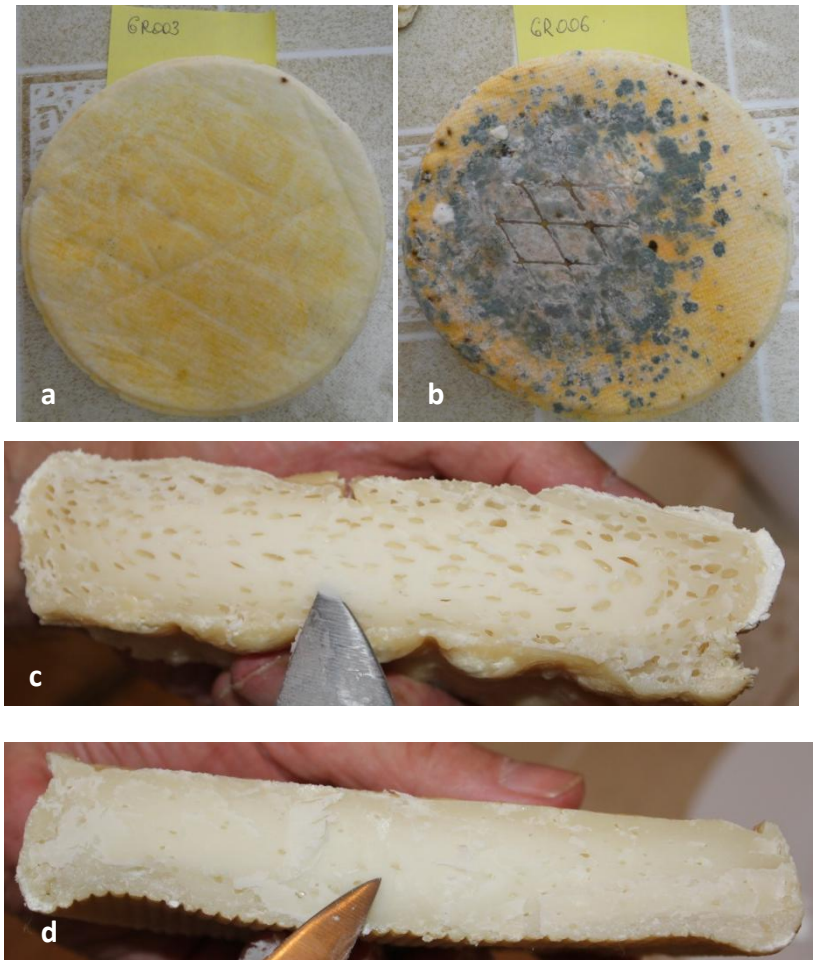

Photo 1. Camel cheese gruyere type. **a**. non-cooked type. **b**. cooked type. **c**. section of non-cooked cheese. **d**. section of cooked cheese.

Table 2. Number of bacteria in one gram of camel cheese type gruyere

Cheese nb	Total microflora	Coliform	St.aureus	Lactobacillus	Streptococcus	Moistures
1	$5,4*10^{-7}$	n d	n d	n d	$7,7*10^{-7}$	nd
2	$1,6*10^{-5}$	n d	n d	n d	$3,3*10^{-5}$	nd
3	$3,4*10^{-6}$	n d	n d	$1,3*10^{-4}$	$4,1*10^{-6}$	nd
4	$1,6*10^{-7}$	n d	10	$5,5*10^{-4}$	$6,1*10^{-6}$	nd
5	$10^{-8}<$	n d	6	$9,6*10^{-6}$	$10^{-8}<$	Penicillium
6	$10^{-8}<$	n d	n d	$8,7*10^{-6}$	$10^{-8}<$	Penicillium
7	$1,5*10^{-8}$	n d	n d	$5,3*10^{-6}$	$10^{-8}<$	Penicillium
8	$9,3*10^{-6}$	n d	nd	$5,6*10^{-6}$	$3,2*10^{-7}$	nd
9	$1*10^{-8}$	n d	nd	$6,6*10^{-7}$	$2*10^{-8}$	nd
11	$8,5*10^{-7}$	n d	nd	$1,6*10^{-7}$	$2,8*10^{-8}$	nd
12	$6,6*10^{-7}$	n d	nd	$4,3*10^{-6}$	$4,1*10^{-7}$	nd

Conclusion. Camel milk could be processed in to safe cheese with high tasty value, but the yield remains lower than for cow milk.

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