

## HUBUNGAN KERAGAMAN GEN *CSN1S1* DAN *CSN2* PADA TIGA BANGSA KAMBING PERAH TERHADAP PRODUKSI SUSU SERTA PEMANFAATAN KASEIN

### INTISARI

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Penelitian ini bertujuan untuk mengetahui keragaman gen *CSN1S1* dan *CSN2* pada kambing Peranakan Ettawa, Saanen dan Sopera serta mengetahui dampaknya pada fraksi protein susu, kualitas, kuantitas dan efisiensi produksi susu, sifat koagulasi, tekstur keju segar dan produksi peptida bioaktif. Keragaman ditemukan pada gen *CSN1S1* dan dominasi genotipe AF pada ketiga bangsa, serta menyebabkan perbedaan kuantitas kasein  $\alpha_1$  dengan kadar tertinggi pada AA. Gen *CSN2* terdapat keragaman didominasi genotipe CC pada ketiga bangsa, namun tidak menyebabkan perbedaan kadar kasein  $\beta$ . Bangsa kambing PE memiliki kadar kasein  $\alpha_1$  tertinggi daripada bangsa lainnya, namun kasein  $\beta$  sama antar bangsa kambing. Haplotipe AF-CC mendominasi ketiga bangsa, namun bangsa SA lebih beragam. Kambing PE memiliki kadar protein, laktosa, kasein paling tinggi serta kadar glukosa dan albumin darah. Efisiensi produksi protein dan kasein dari protein pakan lebih tinggi PE. Gen *CSN1S1* genotipe AA dan heterozigot lainnya unggul dalam tingginya kadar protein, BKTL, TS, BJ, protein dan kasein Kjeldahl serta kuantitas kasein  $\alpha_1$ . *CSN1S1* mempengaruhi efisiensi protein pakan menjadi kasein  $\alpha_1$ . Gen *CSN2* mempengaruhi produksi 4%FCM pada genotipe AA dan CC, menyebabkan tingginya kuantitas protein, lemak, BKTL, TS, kasein  $\beta$  dan total. Gen *CSN2* berpengaruh pada efisiensi produksi susu, protein dan nitrogen dengan tertinggi pada genotipe AA dan CC. Haplotipe gen *CSN1S1-CSN2* berpengaruh pada kadar protein susu dengan haplotipe tertinggi AA-AC dan AA-CC. Haplotipe menyebabkan perbedaan efisiensi produksi kasein  $\alpha_1$  dan  $\kappa$  tertinggi AA-AC dan AA-CC, namun AA-CC memiliki efisiensi kasein  $\kappa$  paling rendah. Terdapat hubungan kadar protein susu dengan BKTL, TS, BJ dan urea susu, kuantitas susu, efisiensi protein dan nitrogen kasein  $\alpha_1$ . Whey berkorelasi negatif dengan kadar protein, lemak, laktosa, BKTL, TS dan kasein susu. Kadar trigliserida darah berkorelasi negatif pada komponen susu. Masa laktasi berpengaruh pada kadar lemak, TS dan komponen susu. Umur hanya pada kadar lemak susu serta periode laktasi tidak. Susu berkasein  $\alpha_1$  tinggi mengurangi WHC. RCT pada susu berkasein  $\alpha_1$  tinggi lebih cepat dari yang rendah. pH koagulasi lebih rendah pada susu berkasein  $\alpha_1$  rendah. Jumlah rendemen keju susu berkasein  $\alpha_1$  tinggi lebih banyak sejalan dengan hasil sineresis. Keju dari susu berkadar kasein  $\alpha_1$  tinggi memiliki nilai *hardness*, *springiness*, *guminess*, dan *chewiness* yang mengarah pada tekstur keju lebih kompak dan kenyal. Keragaman gen *CSN2* memiliki peptida unik namun tidak layak sebagai ACEi dan penghambat spike protein SARS-CoV-2. Simpulan dari penelitian ini yakni terdapat keragaman gen *CSN1S1* dan *CSN2*. Gen *CSN1S1* memiliki pengaruh pada kualitas susu dan keju, sedangkan *CSN2* pada kuantitas produksi susu, namun tidak menghasilkan peptida bioaktif unik.

Kata kunci: *CSN1S1*, *CSN2*, kambing, kasein, susu, keju.

## THE CORRELATION OF *CSN1S1* AND *CSN2* GENES DIVERSITY OF THREE GOAT BREEDS IN MILK PRODUCTION WITH RESPECTIVE CASEIN APPLICATION

### ABSTRACT

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This research aims to determine the diversity of the *CSN1S1* and *CSN2* genes in Peranakan Ettawa, Saanen, and Sapera goats and determine their impact on milk protein fraction, quality, quantity and efficiency of milk production, coagulation properties, fresh cheese texture and bioactive peptide production. Diversity was found in the *CSN1S1* gene and the dominance of the AF genotype in the three breeds, as well as causing differences in the quantity of  $\alpha$ 1 casein with the highest levels in AA. The *CSN2* gene varied, dominated by the CC genotype in the three breeds, but did not cause differences in  $\beta$  casein levels. PE goat breeds have the highest levels of  $\alpha$ 1 casein than other breeds, but  $\beta$  casein is similar between goat breeds. The AF-CC haplotype dominates all three nations, but the SA breed is highly diverse. PE goats have the highest levels of protein, lactose, casein, blood glucose, and albumin levels. Protein and casein production efficiency from feed protein is higher in PE. The *CSN1S1* gene of genotype AA and other heterozygotes excels in high content of protein, SNF, TS, density, Kjeldahl protein, casein, and quantity of  $\alpha$ 1 casein. *CSN1S1* influences the efficiency of feed protein into  $\alpha$ 1 casein. The *CSN2* gene influences 4%FCM production in AA and CC genotypes, causing high quantities of protein, fat, SNF, TS,  $\beta$ , and total casein. The *CSN2* gene has the highest effect on milk, protein, and nitrogen production efficiency in the AA and CC genotypes. The *CSN1S1-CSN2* gene haplotype influences milk protein levels with the highest haplotypes AA-AC and AA-CC. The haplotypes causing the highest differences in  $\alpha$ 1 and  $\kappa$  casein production efficiency are AA-AC and AA-CC, but AA-CC has the lowest efficiency of  $\kappa$  casein. There is a relationship between milk protein content and SNF, TS, density and milk urea, milk quantity, protein efficiency, and  $\alpha$ 1 casein nitrogen. Whey is negatively correlated with protein, fat, lactose, SNF, TS and milk casein. Blood triglyceride levels are negatively correlated with milk components. The lactation period affects fat content, TS, and milk components. Age only affects milk fat content, but the lactation period does not. High  $\alpha$ 1 casein milk reduces WHC. The RCT on high  $\alpha$ 1 casein milk is faster. The coagulation pH was lower in low  $\alpha$ 1 casein milk. The cheese yield of high  $\alpha$ 1 casein milk was more in line with the results of syneresis. Cheese from milk with high  $\alpha$ 1 casein content has hardness, springiness, guminess, and chewiness, which leads to a more compact and chewy cheese texture. The *CSN2* gene diversity has a unique peptide but is not feasible as an ACEi and SARS-CoV-2 spike protein inhibitor. This research concludes that there is diversity in the *CSN1S1* and *CSN2* genes. The *CSN1S1* gene influences the quality of milk and cheese, while *CSN2* on the quantity of milk production but does not produce unique bioactive peptides.

Keywords: *CSN1S1*, *CSN2*, goat, casein, milk, cheese.