

## DETERMINATION OF TOTAL DISSOLVED SOLIDS IN FRESH COW'S MILK FROM MILK COLLECTION CENTRES IN PERAK

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**ABSTRACT.** Total dissolved solid (TDS) is one of the quality parameters used to determine milk prices under the price incentive programme. Low TDS content may impair the quality of milk and usually receive lesser price. Therefore, the objective of this study is to evaluate the quality of milk produced by dairy farmers from four Milk Collection Centres (MCCs) in Perak based on the milk's TDS content. A total of 4,215 samples of fresh cow's milk were obtained and analysed by Veterinary Research Institute from the year 2019 to 2020. The results revealed that 42.9 % of raw milk received from four MCCs were Grade A, followed by 38.8 % Grade B, and 18.3 % Grade C. MCC Sg. Siput had the highest percentage of samples with Grade A (68.8 %) whereas MCC Parit had the highest percentage of samples with Grade B (54.9 %). MCC Tapah had the highest percentage of samples with Grade C (29.6 %). The average TDS content in milk from four MCCs were Sg. Siput:  $13.00 \pm 1.11$  %, Parit:  $12.26 \pm 0.69$  %, Tapah:  $12.02 \pm 0.70$  %, and Taiping:  $12.61 \pm 1.74$  %. Statistical analysis showed that the mean of total solids content from four MCCs were significantly different ( $p < 0.05$ ). This study indicates that the milk produced by dairy farmers in Perak was within acceptable quality. However, there is a need to continue making improvements to ensure that high quality milk can be consistently supplied.

**Keywords:** total dissolved solid, dairy fresh milk, Perak

### INTRODUCTION

Dairy milk is one of the most popular protein sources in the world, which predominates about 83 % in global milk production due to its excellent nutritional content and is important for human health (Górska-Warsewicz *et al.*, 2019). Moreover, milk minerals are essential for human health and development throughout life, especially during childhood (Muehlhoff *et al.*, 2013). Dairy products are high in calcium, protein, vitamin D, and other minerals that are important for bone health (Rizzoli, 2022). As the world's population grows, the demand for dairy milk is increasing globally. Despite efforts by the Malaysian government, dairy farmers, and other industry partners to enhance local milk production, it remains insufficient causing Malaysia to still heavily relies on imported milk (Sim & Suntharalingam, 2015; Suhaimi *et al.*, 2017). Nevertheless, the Malaysian government

through the Department of Veterinary Services (DVS) continues to monitor the quality, safety, and nutritional values of fresh dairy milk before it reaches the customers.

In Malaysia, Milk Collection Centres (MCCs) serve as a formal market for local farmers to sell their raw milk for a stable income (Loong *et al.*, 2019). Raw milk from local dairy farmers is sent to MCCs which are managed by DVS and plays an important role between the dairy farmers (milk producers) and the milk processor. Moreover, MCC plays a role in supervising and providing technical assistance to farmers to supply the high-quality, safe, and enough milk required by dairy processors. There are four MCCs in Perak which are located in Sg. Siput, Parit, Tapah, and Taiping (DVS, 2014). MCC collect fresh milk from the farmers, sampled and then send them to Veterinary Research Institute (VRI) for quality testing.

Total dissolved solid (TDS) content of milk is the total residue left after the water has been completely evaporated. This refers to the protein, carbohydrates, lipids, vitamins, dissolved gas, and dissolved salts (Mourad *et al.*, 2014). Total dissolved solid can also be defined as a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular suspended form (DVS, 2016). Total dissolved solid content would indicate the quality and composition of raw milk, as well as to grade fresh milk into Grade A, Grade B, and Grade C which then be used by DVS for milk pricing. These results eventually could be used by policymakers to ensure that good quality milk is available for the country. There was a report of TDS content in cow's milk from four MCCs in 2018 (Kalaavathi, *et al.*, 2018).

Therefore, this study aims to obtain further information on whether there is a change in TDS content in the following year and whether there is any quality improvement. Based on these considerations, this study aims to evaluate the TDS content in milk from four MCCs in Perak from 2019 to 2020.

## MATERIALS AND METHODS

### Milk Samples

A total of 4,215 samples of fresh cow's milk were obtained from Sg. Siput, Tapah, Taiping, and Parit MCCs in year 2019 to 2020. The samples were sent to VRI in chilled condition every week on the same day or a day after collection and placed in the water bath at 40 °C for 5 minutes. Following that, the samples were gently mixed and placed in milk container.

### Determination of TDS

Total dissolved solid in milk were analysed using Fourier Transform Infrared (FTIR) spectrophotometer which uses infrared technology (FOSS MilkoScan™ Mars, Hilleroed, Denmark). Determination of TDS value using the FOSS machine complies with milk and liquid milk products ISO 9622:2013 (ISO, 2013) and International Dairy Federation (IDF) 141:2013. Total dissolved solid values from the machine were recorded and results were analysed by grouping the percentage of total solids content according to the three milk grades, namely Grade A (>12.50 %), Grade B (11.76 %-12.49 %), and Grade C (<11.75 %) (Lily Shuhaida *et al.*, 2012).

### Statistical Analysis

Data analysis was done by computing descriptive statistic for the mean, standard deviation, and significant value. In this study, One-Way Analysis of Variance (ANOVA) was used to compare the mean difference between MCCs by using IBM SPSS Statistics Version 22. Significant difference between the means were determined using Turkey HSD test analysis at 95 % significant levels ( $p < 0.05$ ).

## RESULT AND DISCUSSION

A total of 1,751 milk samples were received from MCC Sg. Siput, 849 samples from MCC Parit, 1,532 samples from MCC Tapah, and 73 samples from MCC Taiping. The highest mean of TDS was MCC Sg. Siput with 13.00 and the lowest mean of TDS was MCC Tapah with 12.02. The minimum TDS value was 8.39 from MCC Sg. Siput and the maximum TDS value was 17.74 from MCC Sg. Siput as shown in Table 1.

**Table 1.** Descriptive analysis of total solids for fresh milk quality grading from four MCCs in Perak from year 2019-2020

MCCs	No of samples (n)	Range of TDS (%)	Mean of TDS $\pm$ SD (%)
Sg. Siput	1,751	8.39 - 17.74	13.00 $\pm$ 1.11 <sup>c</sup>
Parit	849	8.86 - 16.25	12.26 $\pm$ 0.69 <sup>a</sup>
Tapah	1,532	9.13 - 15.61	12.02 $\pm$ 0.70 <sup>a</sup>
Taiping	73	9.06 - 17.67	12.61 $\pm$ 1.74 <sup>b</sup>
<b>Total</b>	<b>4,205</b>		

\*Notes: MCC = Milk Collection Centre; TDS = Total dissolve solid; SD = Standard deviation; <sup>a-c</sup> = Mean values with different superscripts indicates significant differences ( $p < 0.05$ )

Of the 4,205 milk samples tested, 1,802 samples (42.9 %) were grade A, followed by 1,632 samples grade B (38.8 %), and 771 samples were grade C (18.3 %) as shown in Table 2. MCC Sg. Siput had the highest percentage of TDS in Grade A. (68.8 %), followed by MCC Taiping (49.3 %), MCC Parit (28.0 %), and MCC Tapah (21.1 %). On the other hand, MCC Parit had

the highest percentage of TDS in Grade B (54.9%), and the lowest percentage was recorded in samples from MCC Sg. Siput (22.6 %), and MCC Taiping (21.9 %). The highest percentage of TDS in Grade C was recorded in samples from MCC Tapah (29.6 %), and the lowest percentage was recorded in samples from MCC Sg. Siput (8.6 %).

**Table 2.** Summary of the milk samples from four MCCs according to the grade A, B and C

	MILK COLLECTION CENTRE				
	SUNGAI SIPUT	PARIT	TAPAH	TAIPING	TOTAL (n)
No. of sample, n (%)	1,751 41.6 %	849 20.2 %	1,532 36.4 %	73 1.7 %	4,205 100%
Grade A, n (%)	1,204 68.8 %	238 28.0 %	324 21.1 %	36 49.3 %	1,802 42.9 %
Grade B, n (%)	396 22.6 %	466 54.9 %	754 49.2 %	16 21.9 %	1,632 38.8 %
Grade C, n (%)	151 8.6 %	145 17.1 %	454 29.6 %	21 28.8 %	771 18.3 %

Analysis of mean TDS was done with four group of MCC using One-Way ANOVA. From the result,  $p$ -value is  $< 0.05$ , and there is significant difference of mean TDS between four MCCs. Further analysis revealed that there were significant differences in the mean of TDS ( $p < 0.05$ ) between all four

MCCs using Tukey HSD from Post Hoc Test. However, a previous study by Kalaavathi *et al.* (2018) found statistically significant differences in the mean total solids content between MCCs, with the exception of Taiping and Parit ( $p > 0.05$ ).

According to the European Union, high quality milk should contain TDS that is not less than 12.5 % (FAO/WHO, 2007). The results of this study showed that milk quality (TDS) in Perak is fairly good, with 42.9 % in Grade A, followed by 38.8 % in Grade B, and 18.3 % in Grade C.

Low TDS composition may be influenced by several factors such as environment, poor animal management practices, genetics, and diseases (Azhar *et al.*, 2016; Ramírez-Rivera *et al.*, 2019). In the production of safe and good quality milk, good husbandry practice should be applied, as prescribed in the guidelines issued by the Department of Veterinary Services, Malaysia (DVS, 2014).

Farmers must participate in regular training and awareness programmes on good animal husbandry practices for the dairy herd in order to improve the TDS of milk. The private sector could also lend a hand as part of their corporate social responsibility by mentoring farmers to improve the quality of milk production. Milk producers should also be educated on the importance of producing the highest-quality milk (Grade A), as it could benefit them in greater incentives. Farms that are performing well in producing the highest milk grade can become models for other farms.

## CONCLUSION

This study indicates that TDS of raw milk produced by farmers in Perak needed to be improved. Hence, the key factors influencing milk quality must be addressed to ensure that raw milk produced meets the quality requirements of local dairy processors. This will reduce reliance on imported milk and simultaneously help the farmers to have a sustainable income from dairy farming.

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