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Evaluating moisture evaporation rate of *dahi* at room conditions and at refrigeration conditions by using simulation models

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Abstract
Dahi, a cherished traditional delight from the Indian subcontinent, is obtained through the lactic acid fermentation of milk. The secret to its longevity lies in the controlled storage, where the dance of moisture evaporation dictates its shelf life. Refrigeration is desirable, as room temperature hastens its demise, and the expanse for moisture to dissipate adds to its weight loss during storage. Our study embarked on formulating computational models, envisioning the future of moisture evaporation under varied storage. The highest moisture removal of 0.222± 0.02 g or 0.444% was observed for *dahi* samples stored in plates (0.011 m^2) at 4°C. The loss of moisture was found in kinship with humidity and surface area, with 0.444% evaporation removal in 120 mm Petri plates at 4 °C and a gentle 0.200% loss was observed in 90 mm Petri plates at 37°C. The generated computational models for forecasting moisture loss, showed remarkable alignment (R^2>0.9) with the experimentally obtained results.

Keywords: Relative humidity, computational models, lactic acid fermentation

1. Introduction
The food industry has long aimed to create products infused with vital nutrients like vitamins, probiotics, and polyphenols. These elements enhance our body's functions, bolster nutrition, and support well-being. Their absence can trigger negative effects, underscoring the importance of food enrichment for health. A contemporary trend is the popularity of functional foods worldwide (Abdi-Moghadam *et al.*, 2023) [1]. Notably, dairy, including *dahi*, features prominently in diets. Dahi, a cherished and time-honoured fermented milk delight, reigns as the beloved outcome of milk's lactic transformation in the Indian subcontinent. Enriching *dahi*, a widely accepted and affordable choice, effectively combats diseases linked to nutritional gaps. So, the storage study of *dahi* becomes a matter of concern. The rate of moisture evaporation is key factor in deciding the shelf life of *dahi* at controlled storage conditions (Kamruzzaman *et al.*, 2002) [3]. The storage of *dahi* at room conditions leads to faster spoilage than at refrigerated conditions, while the availability of free surface area for moisture evaporation is another prime factor in weight reduction of *dahi* during storage period. The development of computational models for predicting the amount of moisture evaporated from *dahi* during storage at room conditions and refrigerated conditions facilitates in time saving and resource saving. Therefore, this research was aimed at development of computational models to predict the rate and amount of moisture evaporated from *dahi* during storage at room condition and at refrigerated conditions.

2. Material and methods
Raw milk was purchased from local market. The purchased milk was then heated for 10 min at 90 °C. It was inoculated with 2% back sloping and then incubated at 37 °C for 10 h. After setting of curd, it was weighed and stored at room condition and refrigerated conditions in Petri plates of different capacities. The temperature of 37 and 4 °C were maintained at room conditions and refrigerated conditions, respectively, whereas the relative humidity of 48 and 35%, respectively. Two set of Petri plates of 5 and 10 cm diameter were used to evaluate the relation between surface area and rate of moisture evaporation from *dahi*. *Dahi* samples (No. 1, 2, 3) were kept in Petri plates of 90 mm diameter at room conditions, while sample no.

4, 5, and 6 were kept inside the refrigerator in 90 mm diameter Petri plates. The large sized Petri (120 mm) were filled with *dahi* sample no. 7, 8 and 9, and stored at room conditions whereas three other samples (10, 11 and 12) of *dahi* were kept in large sized plates (120 mm) and stored at refrigerated conditions. The free surface area of *dahi* samples were 0.0064 m^3 and 0.011 m^3 for small and large sized Petri plates, respectively.

The initial weight of *dahi* sample was noted (W_1), and then weight of same sample was again noted after every 2 h for storage study of 18 h. The amount of moisture evaporated was calculated by using equation 1.

$$\text{Moisture evaporated (\%)} = (W_1-W_2)/W_1)) *100 \quad (1)$$

Then, the development of computational models to predict the amount of moisture evaporated was done on the basis of obtained experimental results.

3. Result and Discussion

The prepared *dahi* samples with 25 inoculum showed different rates of moisture removal with respect to the storage conditions and plate size. The amount of moisture lost (%) during storage of *dahi* at 37 and 4 °C in 90 mm Petri plate is presented in table 1, whereas the table 2 contains the amount of moisture evaporated at set conditions in 120 mm Petri plates.

Table 1: Average amount of moisture evaporated in small sized Petri plate

Time (h)	Sample weight (g) at room conditions (37 °C)	Moisture evaporated (%)	Sample weight (g) at freezer conditions (4 °C)	Moisture evaporated (%)
0	50.000±0.0032	0	50.000±0.0026	0
4	49.984±0.0028	0.032	49.980±0.0032	0.04
8	49.977±0.0018	0.046	49.972±0.0023	0.056
12	49.968±0.0029	0.064	49.958±0.0031	0.084
14	49.949±0.0017	0.102	49.937±0.0048	0.126
16	49.938±0.0101	0.124	49.922±0.0094	0.156
20	49.926±0.0081	0.148	49.908±0.0076	0.184
24	49.900±0.0090	0.2	49.876±0.0105	0.248

It can be inferred from the data that amount of moisture evaporated (%) increases with increase in storage period, while *dahi* stored at 4 °C showed higher amount of water evaporation than the one stored at 37 °C. It was due to the lower relative humidity inside the refrigerator than the room conditions.

Table 2: Average amount of moisture evaporated in large sized Petri plate

Time (h)	Sample weight (g) at room conditions (37°C)	Moisture evaporated (%)	Sample weight (g) at freezer conditions (4°C)	Moisture evaporated (%)
0	50.000±0.0029	0	50.000±0.0019	0
4	49.976±0.0025	0.048	49.961±0.0053	0.078
8	49.954±0.0034	0.092	49.935±0.0029	0.13
12	49.938±0.0031	0.124	49.917±0.0053	0.166
14	49.916±0.0076	0.168	49.904±0.0056	0.192
16	49.893±0.0091	0.214	49.862±0.0088	0.276
20	49.856±0.0065	0.288	49.802±0.0079	0.396
24	49.809±0.0049	0.382	49.778±0.0029	0.444

The comparative study to examine the effect of surface area on amount of moisture evaporated showed that higher amount of water is lost from Petri plate having 120 mm diameter due to availability of higher surface area as compared to the Petri plate with 90 mm surface area. Similar increasing trend was observed as amount of water evaporated (%) from *dahi* was higher with prolonged storage period (h). When free surface area was increased by 71.87%, an increase of 79 and 91% in moisture removal was noticed for *dahi* samples stored at 37 and 4 °C, respectively after storage period of 24 h. Similar results were obtained by some authors. (McCutchan *et al.*, 1951) [4]. The graphical representation of average moisture evaporated (%) from *dahi* stored at 37 and 4°C in small and large sized Petri plates is shown in figures 1, 2, 3 and 4.

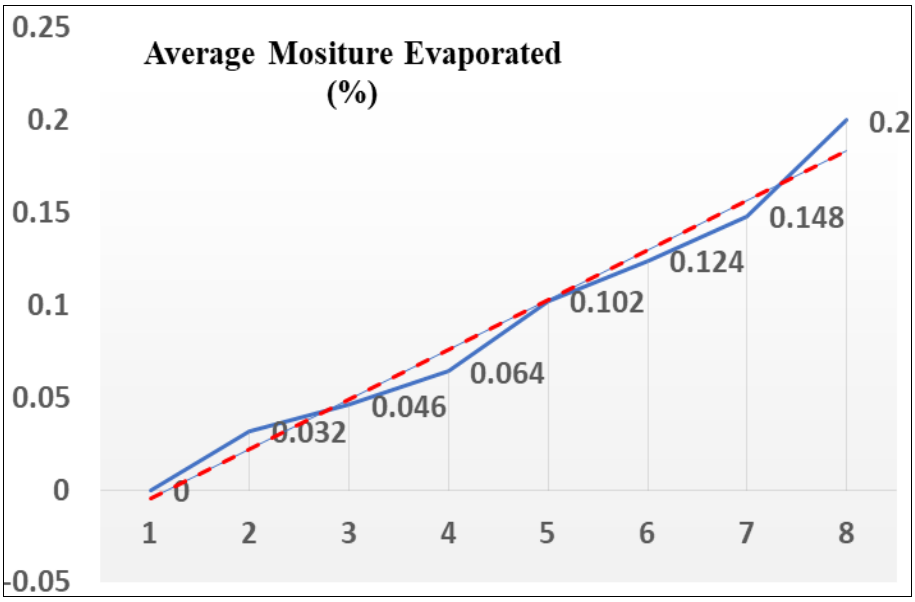

Fig 1: Average moisture evaporated (%) from dahi in small sized Petri plate stored at 37 °C

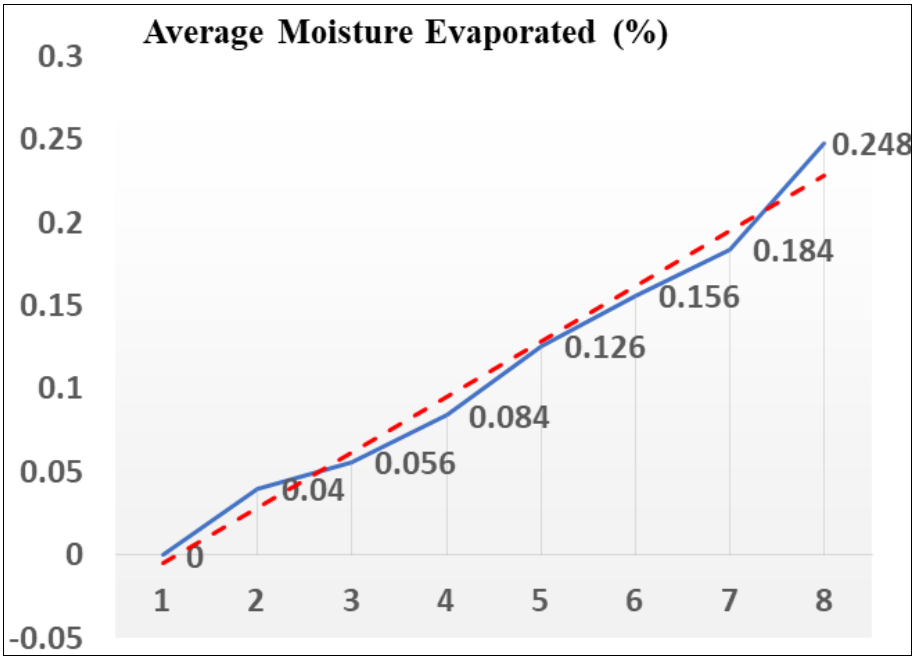

Fig 2: Average moisture evaporated (%) from dahi in small sized Petri plate stored at 4 °C

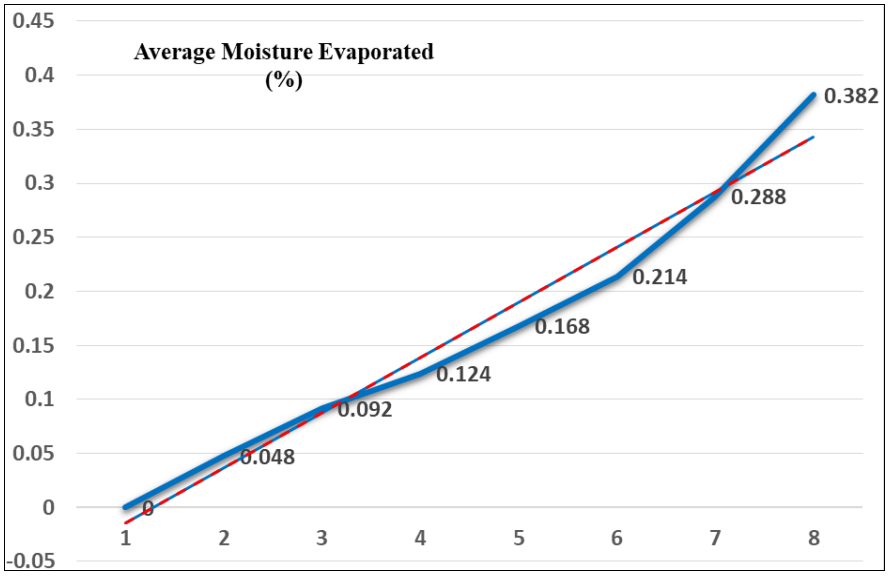

Fig 3: Average moisture evaporated (%) from dahi in large sized Petri plate stored at 37 °C

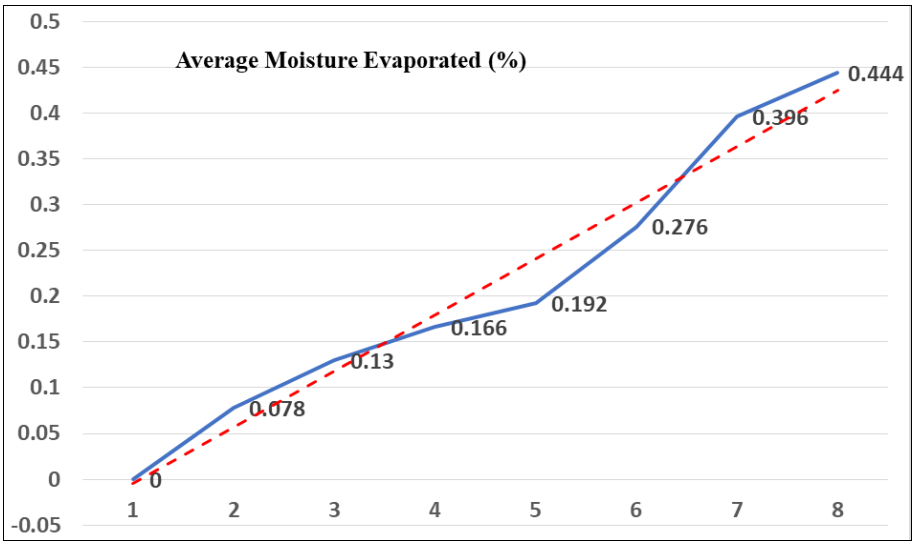

Fig 4: Average moisture evaporated (%) from dahi in large sized Petri plate stored at 4 °C

It can be seen clearly that highest amount of moisture was evaporated (0.444%) from *dahi* sample stored in large Petri plate at 4 °C and rate of moisture evaporation shown direct relation with the duration of storage. The obtained results were in good agreement with the findings of some authors (Ribeiro *et al.*, 2020) [5]. The obtained results were also supported by the findings of previous studies (Uddin and Islam, 1985) [6]. Computational models were developed, as depicted in table 3, to predict the amount of moisture removed (%) on the basis of experimental data obtained for storage of *dahi* samples at 37 and 4 °C in small sized Petri plates (Equations 2 and 3, respectively). The equations 3, and 4 predicted amounts of moisture evaporated (%) from *dahi* samples stored at 37 and 4 °C in 120 mm Petri plates, respectively. The computational models accurately predict the moisture reduction from *dahi* sample, demonstrating a strong correlation (R^2>0.9) with actual experimental results. Similar findings were noted by some researchers as well. (Broker *et al.*, 1974) [2]

Table 3: Computational models for predicting the moisture loss from *dahi* during storage

Parameters	Computational Model	Eq.
Amount of water evaporated (%) in small sized Petri plate at 37 °C	y = 0.0268x - 0.0311 R^2 = 0.9789	2
Amount of water evaporated (%) in small sized Petri plate at 4 °C	y = 0.0333x - 0.0381 R^2 = 0.9819	3
Amount of water evaporated (%) in large sized Petri plate at 37 °C	y = 0.051x - 0.065 R^2 = 0.9706	4
Amount of water evaporated (%) in large sized Petri plate at 4 °C	y = 0.0615x - 0.0663 R^2 = 0.9678	5

4. Conclusion

It can be concluded from the experimental study that the amount of moisture evaporated from *dahi* sample showed a direct related with relative humidity (%) of storage conditions, the availability of free surface area (m^3). The highest average moisture removal value of 0.444% was obtained for *dahi* samples stored in 120 mm Petri plates at 4 °C whereas the lowest average moisture evaporation of 0.200% was noticed for *dahi* samples stored in 90 mm Petri plates at 37 °C. When the available surface area (m^3) was expanded by 71.87%, the *dahi* samples stored at 37 and 4 °C exhibited remarkable growth of 79 and 91% was noticed in average moisture lost after 24 h, respectively. The experimentally obtained results were significantly different (p<0.05). The formulated computational models, for predicting the average amount of moisture removal from *dahi* samples, showed high degree of correlation (R^2>0.9) with the experimentally obtained data.

5. References

1. Abdi-Moghadam Z, Darroudi M, Mahmoudzadeh M, Mohtashami M, Jamal AM, Shamloo E, *et al*. Functional yogurt, enriched and probiotic: a focus on human health. Clinical Nutrition ESPEN; c2023.
2. Broker DB, Bakker FW, Hall CW. Drying of cereal grains, theory and simulation of cereal grain drying. The AVI Publications Co. INC. USA. 1974;1(1):185.
3. Kamruzzaman M, Islam MN, Rahman MM, Parvin S, Rahman MF. Evaporation rate of moisture from dahi (yogurt) during storage at refrigerated condition. Pakistan Journal of Nutrition. 2002;1(5):209-211.
4. McCutchan JW, Taylor CL. Respiratory heat exchange with varying temperature and humidity of inspired air. Journal of Applied Physiology. 1951;4(2):121-135.
5. Ribeiro AC, Lemos ÁT, Lopes RP, Mota MJ, Inácio RS, Gomes AM, *et al*. The combined effect of pressure and temperature on kefir production-a case study of food fermentation in unconventional conditions. Foods. 2020;9(8):1133.
6. Uddin MB, Islam MM. Development of self-stable principal products by different methods of drying. sJournal of Institute of Engineers. 1985;1(13):5-13.