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**MACHINE LEARNING MODELS FOR PREDICTION OF ADDED WATER IN
MILK AS A FUNCTION OF MILK TEMPERATURE AND SOME OTHER
PHYSICAL CHARACTERISTICS**

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ABSTRACT Several methods have been reported to detect the water content in milk. However, most of these methods are expensive and time consuming. It has therefore become necessary to develop and improved a method for the rapid and reliable detection of this kind of fraud. The added water in milk has an important influence on milk electrical conductivity, density, fat, total solids, total solids-not-fat, pH, etc. Some of these parameters, including electrical conductivity are strongly dependent on temperature. It expected with knowing all of these parameters and using machine learning methods, the amount of added water in milk is calculated. Milk samples were prepared by adding ultra pure water to untreated cow's milk (raw milk) to achieve the required volume percent water (0, 0.5, 1, 1.5, 2, 2.5, 3, 5, 10, 15, 20, 25, 30, and 35%). For each milk sample and at different temperatures (4, 7, 7.6, 10, 12, 13, 17, 18, 20, 22, 23, and 25 °C) the electrical conductivity, milk density, fat, total solid, total solid not fat, and pH were measured. Various back-propagation artificial neural networks (ANN) with 7 neurons in the input layer and 1 neuron in output layer (percent added water) were investigated. The results showed that added water in milk had a linear decreased effect on all measured milk properties. It was found that temperature had an increasing effect on electrical conductivity of milk. The best ANN model produced a correlation coefficient of 0.963 between the actual amounts of added water and the predicted amounts. This method provides a rapid and reliable method for prediction of added water in milk.

Keywords: Milk, added water prediction, machine learning, ANN.