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13436-00

Release Date:</td></tr>
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Production Filename: 13436 (In Product Library)

Path to Working Files: DecaDoc\Application Notes\Master

Dimensions: 8.5 inch wide, 11 inch tall

Material: Paper, 92 Bright White or better, 75g/m² or heavier

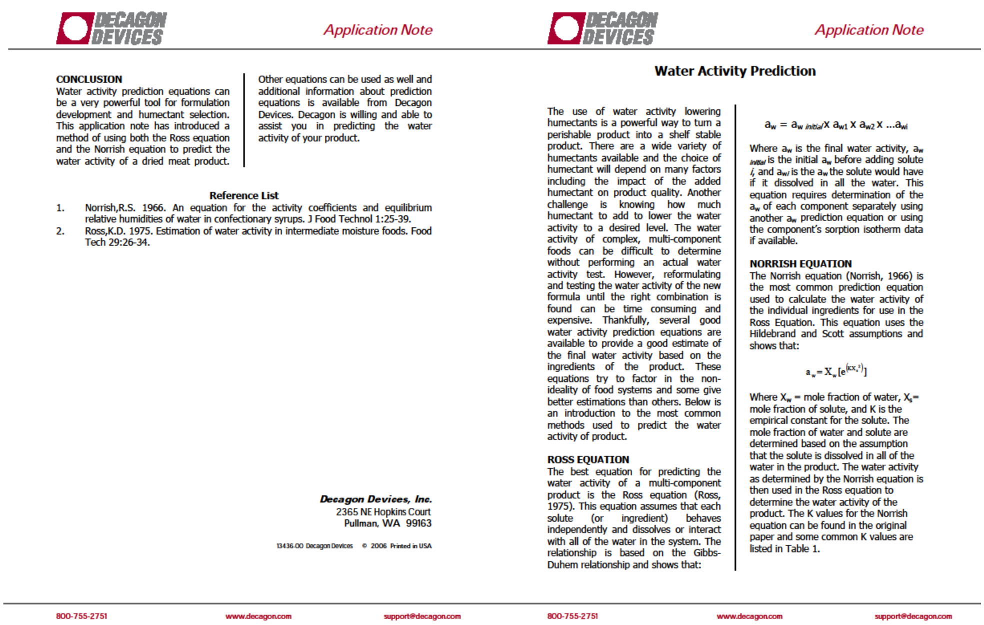
Colors: Color Print on White

Printer: HP Color LaserJet 8550-PS

Finish: None

Adhesive: None

Special Notes: Illustrations are Ref Only ** Not to Scale ** (Shown page 1 of 2)



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CONCLUSION
Water activity prediction equations can be a very powerful tool for formulation development and humectant selection. This application note has introduced a method of using both the Ross equation and the Norrish equation to predict the water activity of a dried meat product.

Other equations can be used as well and additional information about prediction equations is available from Decagon Devices. Decagon is willing and able to assist you in predicting the water activity of your product.

Reference List
1. Norrish,R.S. 1966. An equation for the activity coefficients and equilibrium relative humidities of water in confectionary syrups. J Food Technol 1:25-39.
2. Ross,K.D. 1975. Estimation of water activity in intermediate moisture foods. Food Tech 29:26-34.

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DECAGON DEVICES Application Note

Water Activity Prediction

The use of water activity lowering humectants is a powerful way to turn a perishable product into a shelf stable product. There are a wide variety of humectants available and the choice of humectant will depend on many factors including the impact of the added humectant on product quality. Another challenge is knowing how much humectant to add to lower the water activity to a desired level. The water activity of complex, multi-component foods can be difficult to determine without performing an actual water activity test. However, reformulating and testing the water activity of the new formula until the right combination is found can be time consuming and expensive. Thankfully, several good water activity prediction equations are available to provide a good estimate of the final water activity based on the ingredients of the product. These equations try to factor in the non-ideality of food systems and some give better estimations than others. Below is an introduction to the most common methods used to predict the water activity of product.

ROSS EQUATION
The best equation for predicting the water activity of a multi-component product is the Ross equation (Ross, 1975). This equation assumes that each solute (or ingredient) behaves independently and dissolves or interact with all of the water in the system. The relationship is based on the Gibbs-Duhem relationship and shows that:

$$a_w = a_{w\ initial} \times a_{w1} \times a_{w2} \times \ldots a_{wi}$$

Where a_w is the final water activity, $a_{w\ initial}$ is the initial a_w before adding solute *i*, and a_{wi} is the a_w the solute would have if it dissolved in all the water. This equation requires determination of the a_w of each component separately using another a_w prediction equation or using the component's sorption isotherm data if available.

NORRISH EQUATION
The Norrish equation (Norrish, 1966) is the most common prediction equation used to calculate the water activity of the individual ingredients for use in the Ross Equation. This equation uses the Hildebrand and Scott assumptions and shows that:

$$a_w = X_w [e^{(KX_s^2)}]$$

Where X_w = mole fraction of water, X_s= mole fraction of solute, and K is the empirical constant for the solute. The mole fraction of water and solute are determined based on the assumption that the solute is dissolved in all of the water in the product. The water activity as determined by the Norrish equation is then used in the Ross equation to determine the water activity of the product. The K values for the Norrish equation can be found in the original paper and some common K values are listed in Table 1.

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