Crystal Orozco
November 8, 2012
Lab Report

LAB 6: Dehydrated Foods Versus Intermediate Moisture Foods and Moisture Control

I. PURPOSE:

The purpose of this lab was to compare the moisture content between a dehydrated food, potato chips, with an intermediate moisture food, dog food. By calculating the % moisture for each of these food products we are able to make a graph called a moisture isotherm graph comparing its water activity, % moisture content at a specific temperature for that particular food product. This graph will help us determine whether it's either an adsorption or desorption isotherm.

II. INTRODUCTION:

This experiment is very important in helping us understand water activity versus moisture content in food. Water activity and moisture content is not the same thing. Knowing the water content is very important for food industrialists because water activity is an indicator of food spoilage. Water activity can influence four things, non-enzymatic browning, enzymatic activity, vitamin loss, and oxidation. Water activity is a measurement of unbound water where 0 means no water available and 1.0 is pure water.

Most microbial spoilage won't grow at less than or equal to 0.9 water activity. Most yeast won't grow at less than or equal to 0.85 water activity. Most molds won't grow at 0.7 water activity or lower. Lastly, below than or equal to 0.62 water activity no microbial growth is known to occur. This is very important for food industrialists when making a product to help with storing foods. Food industries want foods to be at optimal water activity while in storage to minimize microbial growth, vitamin loss, oxidation, and enzymatic reactions.

Adding hydrophilic substances or humectants to your solvent helps bind water and make water unavailable, helping reduce water activity in foods. Water activity is related to moisture content in a non-linear fashion. We can see their relationship on a moisture isotherm curve. Food industrialists use moisture isotherms because every product is unique and must be determined experimentally for each product. A sorption isotherm can either be a desorption curve where a hydrated food is dehydrated to remove moisture until a desired water activity is reached or it can be a adsorption curve where a hydrated food is completely dehydrated and then rehydrated to a desired water activity. This helps food industrialists understand how moisture will migrate in a food product and its effect it while storage. This is key in predicting optimal product stability for each product in storage.

I. PROCEDURE:

The procedure followed for the experiment is found in "Principles of Food Composition Laboratory Manual" (2012) Experiment 6, Food Preservation by Means of Moisture Control, pages 56-68.

III. DATA/RESULT:

Table 1: Raw Data for Dog Food:

Dog Food					
Solute	Aw	Dish Wt (g)	Dish+ Sample (Initial g)	Dish + Sample (Final g)	% Water (Initial)
K-Acetate	0.225	1.8	5.67	4.61	21.1
Mg(NO3)2	0.52	1.8	5.69	4.8	21.1
NaCl	0.755	1.8	5.8	4.85	21.1
KCl	0.845	1.8	5.8	5.6	21.1
KNO3	0.93	1.8	5.8	6.2	21.1

Table 2: Raw Data for Potato Chips:

Potato Chips					
Solute	Aw	Dish Wt (g)	Dish+ Sample (Initial g)	Dish + Sample (Final g)	% Water (Initial)
K-Acetate	0.225	1.8	4.14	4.129	0
Mg(NO3)2	0.52	1.8	4.18	4.23	0
NaCl	0.755	1.8	4.25	4.46	0
KCl	0.845	1.8	4.14	4.51	0
KNO3	0.93	1.8	4.12	4.86	0

Table 3: Calculated Data for Dog Food:

Dog Food						
Solute	Aw	WT (initial) (g)	WT (final)(g)	WT (dry) (g)	% Moisture Final	% Moisture Change
K-Acetate	0.225	4	2.81	3.156	-10.9632	-37.7060
Mg(NO3)2	0.52	4	3	3.156	-4.9430	-31.6857
NaCl	0.755	4	3.05	3.156	-3.3587	-30.1014
KCl	0.845	4	3.8	3.156	20.4056	-6.3371
KNO3	0.93	4	4.4	3.156	39.4170	12.6743

Table 4: Calculated Data for Potato Chips:

Potato Chips					
Solute	Aw	WT (initial) (g)	WT (final)(g)	WT (dry) (g)	% Moisture Final
K-Acetate	0.225	2.5	2.329	2.5	-6.84
Mg(NO3)2	0.52	2.5	2.43	2.5	-2.8
NaCl	0.755	2.5	2.66	2.5	6.4
KCl	0.845	2.5	2.71	2.5	8.4
KNO3	0.93	2.5	3.06	2.5	22.4

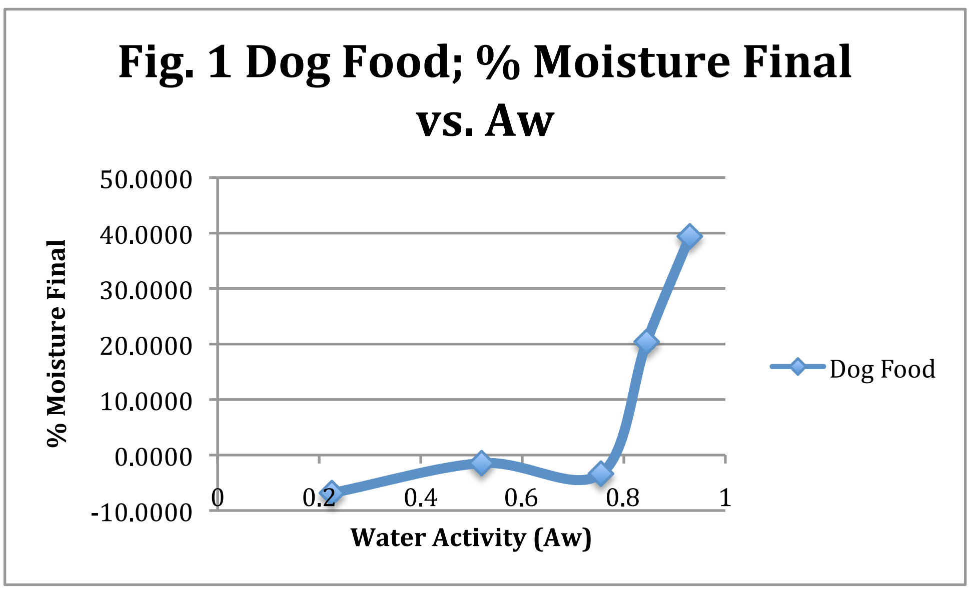

Figure 1: IMF graph (Dog Food) graphing % Moisture final vs. Aw

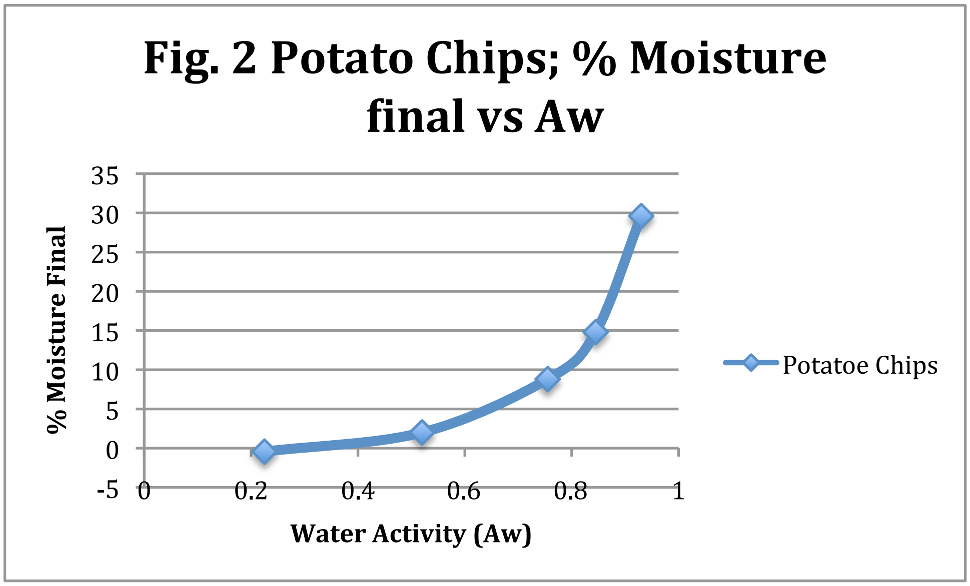

Figure 2: Dehydrated graph (Potato chips) graphing % Moisture final vs. Aw

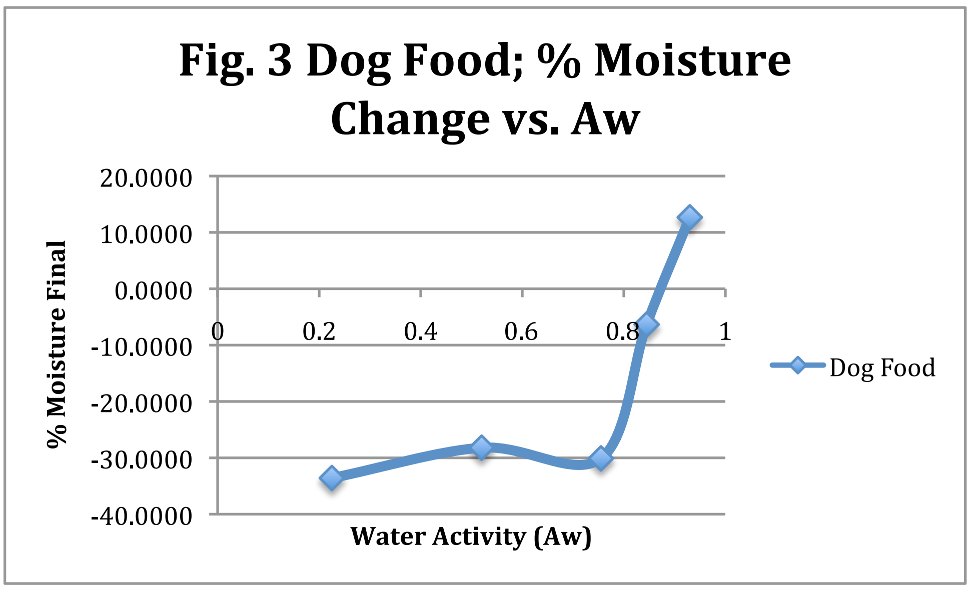

Figure 3: % Moisture Change (Dog Food) graph vs. Aw

V. Calculations:

Example of Dry Sample Weight Example:

WTdry= (1-Xwater)WTinitial

For Dog Food (K-acetate Solute):

WTdry= (1-0.211)4.0g= 3.156g WTdry

Example of % Moisture Final (dry weight basis):

[(WTfinal- WTdry)/WTdry] x 100

For Dog Food (K-acetate Solute):

[(2.81g- 3.156g)/ 3.156] x 100= -10.96% Moisture Final

% Moisture Change (dry weight basis) Example:

[(WTfinal- WTinitial)/WTdry] x 100

For Dog Food (K-acetate Solute):

[(2.81g- 4.00g)/3.156g] x 100= -37.71% Moisture Change

VI. Discussion:

The % RH varies for every product is established in the chamber based upon the different solutes and whether or not they are good humectants. A product that gains moisture the ERH will be less than the RH. If a product loses moisture the ERH will be greater than the RH.

Although knowing the water content in a food or moisture is informative, it does not tell us how the water exists in the food whether it is unbound or bound in the food. This is why knowing the optimal water activity in foods is important. The water activity gives us a number tell us how much free or bound water there is. The more free water or unbound water the more chances of microbial growth. The solutes that bind water are humectants, solutes that bind water and reduce water activity in foods. You can also alter the environment by freezing, dehydration, and as previously stated adding a humectant to adjust the water activity.

Moisture greatly affects the qualities of a food. Too much moisture could lead to spoilage. Spoilage can also occur with even small changes in relative humidity so it is important to calculate each products optimal water activity and to study how moisture will play in each product while stored.

If we look at the potato plot comparing the % moisture final with water activity (aw) these shows an adsorption isotherm that means that our food product was completely dehydrated. The water activity for potato chips is 0, which is expected if something is completely dehydrated. It has very little chance or likelihood of microbial growth due to the very low water activity. Since our product was completely dehydrated it can not lose moisture and it’s only option is to gain moisture from the system which means that

RH>ERH. Different water activities have different moisture contents, which is also expected because depending on the solute, the water binding is affected. For example if we look at KCl, it's water activity is 0.845 which showers a much higher moisture content than K-acetate with a water activity of 0.225. Some potato chips will be able to gain more moisture depending on the specific solute.

The dog food, being an intermediate moisture food, has moisture content of 21.1% and has a water activity of 0.75-0.85. With such high water activity it is more susceptible to microbial growth than are the potato chips. Being moist and being bound by humectants decreases its water activity and making it fairy stable against microbial spoilage but just more susceptible in comparison to potato chips. Overall we see that the dog food is a both a desorption isotherm and an adsorption isotherm depending on whether the relative humidity is larger than the water activity of the food or not depending on the solute.

There could have been some sources of error in this experiment, for example during measurement of the samples, it is easy to not weigh out the proper amounts or properly label all the containers with the correct solutes. It is also hard to understand these moisture content and isotherm concepts, so improper or inaccurate data analysis is also a source of error.

VII. CONCLUSIONS:

Overall, I learned a lot about water activity vs. moisture content in food products. I learned how important the effects of understanding the relationship of these two terms is greatly important for food industrialists to produce a high quality product at it's most optimal stability for food preservation and storage. I learned that there is a big difference between dehydrated foods and intermediate moisture foods in terms of food spoilage. Intermediate moisture foods have a higher chance of microbial spoilage compared to potato chips because it has more moisture and higher water activity that make it more susceptible to microbial spoilage.

Our method was an okay experiment in helping us understand because we compared a completely dehydrated food with 0% moisture content with an Intermediate moisture food having 21.1% moisture content. I think doing the isotherm graphs helped me visually see the desorption and moisture adsorptions but even then, I felt like these concepts were very hard to full grasp and really understand. It would have helped more if we got an in depth overview before the lab started as to maybe a broader understanding.

Another disadvantage was that this lab was extremely short, I felt like maybe I did not understand it as much as I should have because my lab just weighed samples that were left over break and then somehow we were suppose to understand what that meant. These are very important and difficult concepts, next time I would advise to talk about them more in lab and in class.

VIII. QUESTIONS:

1. The plot of the % moisture final vs. aw for the dehydrated food that I have drawn is an adsorption isotherm. The way we could measure a desorption isotherm is to change the temperature. Temperature greatly affects aw which can have an effect on whether it is a desorption or adsorption isotherm.

2. The initial water activity of the dog food is 0.9. We can tell this by looking at the % change vs. aw graph. This value would not be stable again microbial spoilage because at 0.9 water activity there is a very high likelihood that pathogens will grown. Anything about 0.6 water activity means there is microbial growth susceptibility and the closer the value is to 1, the more likelihood. The higher the Aw means the more water unbound and the more chances for the water to participate in deterioration reactions.

3. The dog food would correspond to both a desorption and adsorption isotherm because from our graph we can see that we obtain negative values which means that our product is losing moisture. And other parts the % final moisture was positive values. Ultimately the dog food is both depending on whether the relative humidity is larger than the water activity of the food or not.