

Experiment into the impact of existing salt content within a hot dog on its mummification.

Abstract

When mummifying hot dogs, the hot dog brand used may affect its capacity to be mummified due to differing levels of salt content. The following experiment was conducted in the context of hot dog mummification, wherein other experiments were undertaken to determine the efficiency of different salt mixtures on the process to contextualise the use of natron by the Ancient Egyptians. Assorted brands of hot dog were weighed, covered in salt, and repeatedly measured over the course of 16 days. Results showed a weak correlation between salt content and average weight lost over this period and additional weak correlations with other factors, such as stabilisers. This could be explained by other variables within the hot dog ingredients, as well as technological and human error.

Key Words

- Mummification
- Osmosis
- Salt
- Hot Dog
- Stabilisers

Introduction

This experiment was conducted to examine if the hot dog brand, and its corresponding salt content, would affect the process of mummification, including the amount of weight lost during the process, and the speed at which this occurs. The hypothesis is that brands with a higher salt content would mummify slower and lose less weight overall than those with a lower salt content.

The hypothesis derives from the process by which the hot dogs are mummified. Mummification refers to “the technique of preserving a human or animal body according to rites practiced in ancient Egypt,”¹ done through a treatment of natron to dry out the human or animal body. Mummification in its entirety also includes the wrapping of the body in bandages, as well as accompanying rites and ritual². For the purposes of this experiment, the wrapping of the specimen in bandages and practices of rites will not be undertaken. The drying of the specimen will be the focus, and

¹ (“Mummification,” 2008)

² (“Mummification,” 2008)

therefore its loss in weight. The drying takes place through osmosis, “the passage of a solvent through a semipermeable membrane separating two solutions of different concentrations... will stop when the two solutions reach equal concentration.”³ Within this experiment, the hot dog is the semipermeable membrane, and the salt on either side of the hot dog the ‘solutions.’ With undilute salt on the outside of the hot dog, and a dilute solution of salt within the hot dog, water will move through the hot dog to the salt on the outside of the hot dog, ideally until both sides are equally dilute. With enough salt, most water should be drawn from the hot dog.

Osmosis can be affected by several factors, the most relevant being temperature, surface area, and concentration gradient. The kinetic energy of water increases with temperature and a higher temperature results in faster movement⁴. A larger surface area increases the rate as there is a larger area of semipermeable membrane for the water to diffuse through⁵. Finally, a greater concentration gradient increases the rate, meaning a larger difference between the concentration of salt on either side of the membrane⁶. This is the main factor influencing the hypothesis, as the hot dogs with a larger existing salt content have a smaller concentration gradient, theoretically impacting the rate of osmosis and making it slower. However, the other factors cannot be ignored and will be discussed in the following section.

Method

Hot dogs were chosen for their availability, though some care was given to ensure a differing amount of salt from each brand. The five chosen were Kingsfood, Herta, Wikinger, Dino’s, and Berlinki. The differing salt content was not the only variable present throughout the brands. One came in a can, Kingsfood, one in a jar, Wikinger, and the other three in refrigerated packets. All five brands used the same preservative, E250, though there were some slight differences in stabilisers. Kingsfood and Berlinki contained no stabilisers, Herta contained an additional preservative in a lactic acid culture, and Wikinger and Dino’s contained similar stabilisers: E450, E451, E331iii, and E450, E451, E452, respectively. Additionally, there were some differences in the percentage and type of meat used throughout each hot dog (see Appendix 1). These variables could not be controlled, and their potential effect on results will be discussed within the results.

Other variables were present that could be controlled. Each hot dog was weighed and accordingly cut to size to ensure all had the same weight. However, weight does not equal surface area, a factor that will be discussed in the results. Temperature and humidity were controlled as much as possible with no controllable environment

³ (“Osmosis,” 2020)

⁴ (AAT Bioquest, 2024)

⁵ (AAT Bioquest, 2024)

⁶ (AAT Bioquest, 2024)

present to conduct the experiment within; the hot dogs were stored in a cool, dark place to attempt to maintain a consistent temperature and humidity. The same type and salt brand was used across all the hot dogs, a standard table salt with the anti-caking agent sodium ferrocyanide. The same weight of salt was used for each hot dog. A control hot dog for each brand was not used as the hypothesis was that each hot dog would undergo some form of weight change as a result of being covered with the salt, and to examine how the hot dog mummifies, rather than if. Finally, the scales used for the experiment were not reliable, so three measurements were taken to determine an average weight, to account for any error.

The experiment was conducted using the following method:

- Acquire five assorted brands of hot dog with differing salt contents
- Weigh out 24 grams of hot dog
- Weigh out 250g of salt
- Put salt and hot dog into ziploc bag
- Ensure coverage of the hot dog with salt
- Seal ziploc bag, removing as much air as possible
- Repeat for each hot dog, labelling each bag with the brand

Measurements were taken by doing the following:

- After five (two*) days, remove the hot dog from the ziploc bag
- Remove as much salt as possible from the hot dog
- Weigh the hot dog three times
- Record results
- Place the hot dog back into the ziploc bag, re-cover with salt, and seal the ziploc bag, removing as much air as possible
- Repeat for each hot dog

*Weighing was initially done every five days, but this was increased to every two days as explained in discussion of results.

Figure 1 displays the brands chosen and their salt content per 100 grams, and their salt content per 24 grams as used in the experiment from least to most salt content.

	Salt Content /100g	Salt Content /24g
Kingsfood	1.24	0.2976
Herta	1.61	0.3864
Wikinger	2.00	0.4800
Dino's	2.10	0.5040
Berlinki	2.50	0.6000

Figure 1. Table showing brands of hot dog and their corresponding salt content.

Results

Figure 3 is a line graph and table showing the average weight against time for each hot dog brand. Initially, measurements were to be taken every five days. On observation of the large increase in average weight across all the brands on day ten, it was determined that measurements should take place more frequently to determine if water might have moved back into the hot dogs, and, if it had, allow it to be observed. Full results of measurements can be found in Appendix 2. Figure 2 is a bar chart displaying the starting and final average weights. Observations were made throughout the course of the experiment. The hot dogs remained the same in appearance but became hard as they dried. Salt stuck to them for most measurements, but by day 16 had become much easier to remove from the hot dogs. The salt itself became clumpy and visibly damp as soon as day 5, which would continue throughout the experiment. The smell was continuously 'hot dog.'

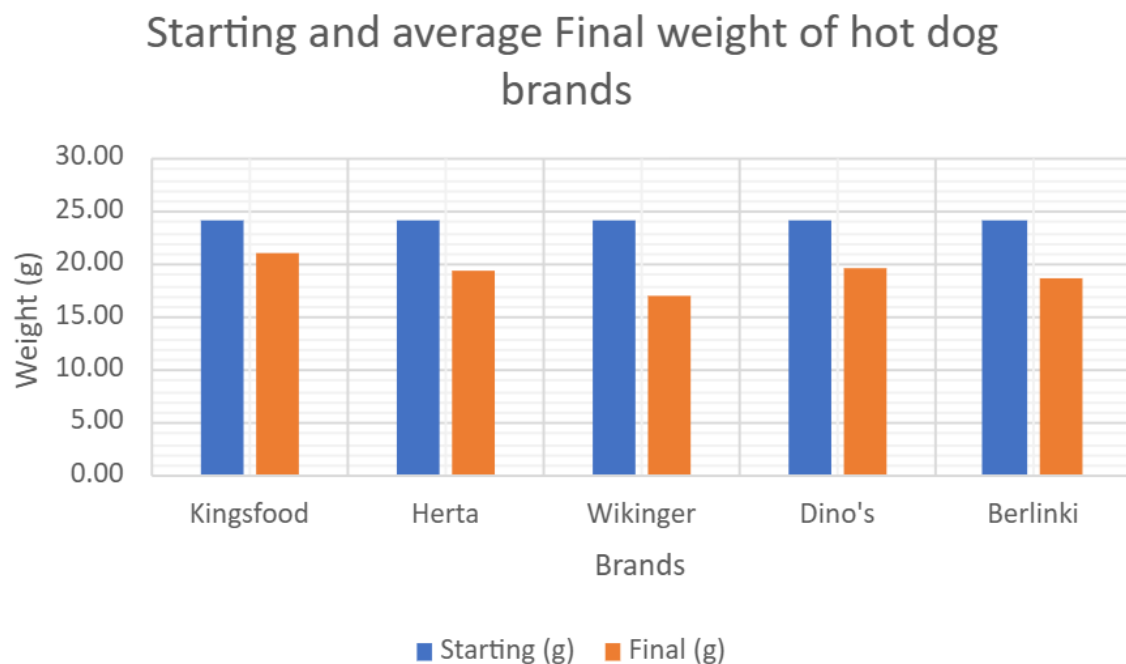


Figure 2. Bar chart showing Starting weight and average Final weight of hot dog brands

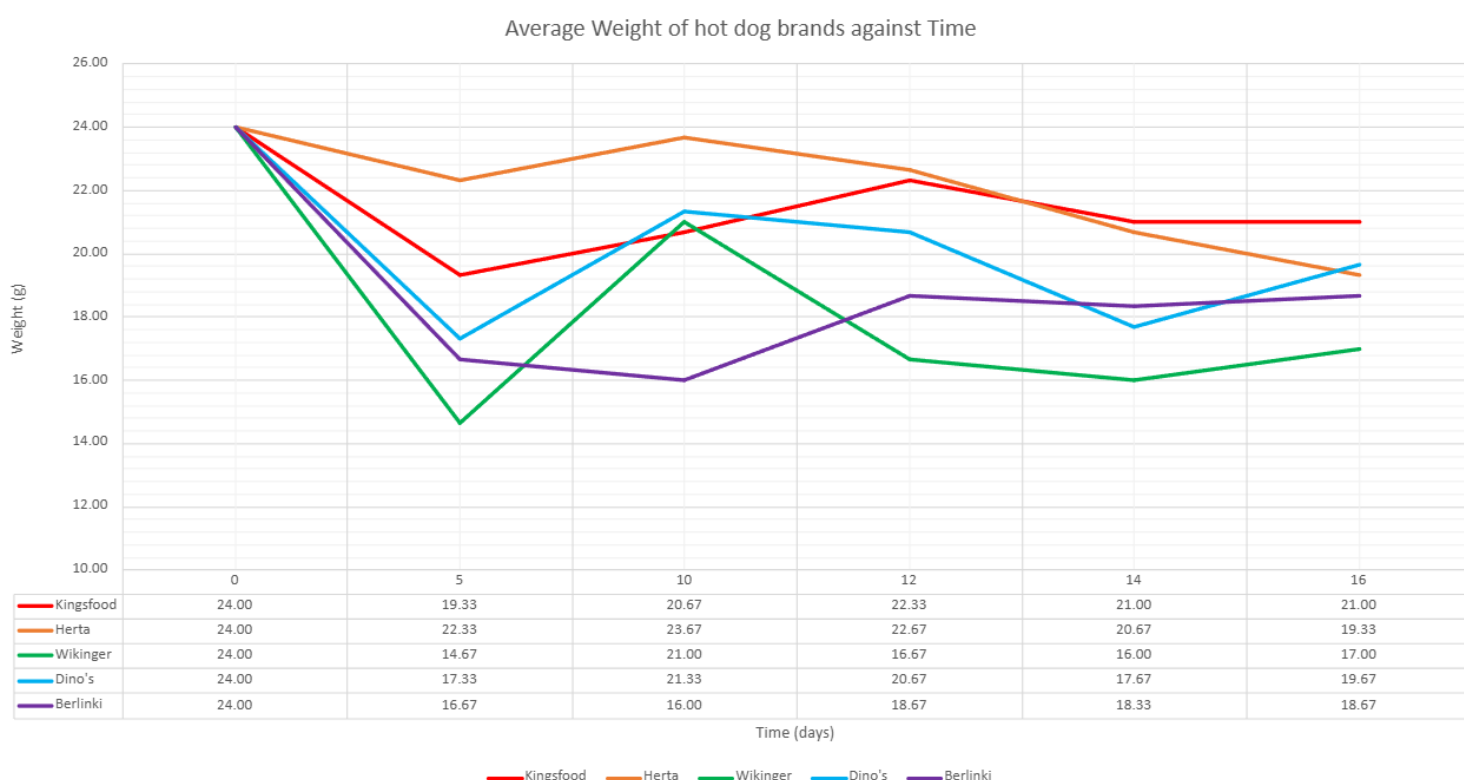


Figure 3. Line graph and table showing the average Weight of hot dog brands against Time

The first measurement taken on day five shows a decrease across all brands of hot dog. The largest difference in average weight comes from the Wikinger brand hot dog, and the smallest from the Herta brand, with original salt contents of 0.4800g and 0.3864g per 24g, respectively. Day ten shows an increase in average weight for all brands but one, Berlinki, which possesses the highest salt content at 0.6000g. This increase in weight could be explained by water moving back into the hot dogs as the solution becomes more dilute outside of the hot dog, resulting in the movement of water back into the hot dog. As explained above, measurements were taken more frequently to better observe the movement of water in and out of each hot dog. Day 12 shows a decrease in average weight for three brands, and an increase in average weight for two. This could be expected for the Berlinki hot dogs, as they had not displayed an increase in weight the days prior. Day 14 shows a return to a general decrease in average weight for all the brands of hot dogs. Day 18 shows a slight increase in all but two of the brands. The changes in average weight have become less dramatic by this point and may indicate the reaching of equilibrium. Overall, each brand loses a significant amount of weight.

	Total +/- (g)	Av. +/- (g)
Kingsfood	-3.00	-0.60
Herta	-4.67	-0.93
Wikinger	-7.00	-1.40
Dino's	-4.33	-0.87
Berlinki	-5.33	-1.07

Figure 4. Table showing total gain / loss and average gain / loss of weight.

There appears to be some correlation between amount of salt present within the hot dog to begin and the amount of weight lost. However, the relationship appears to be inverse compared to the hypothesis, where higher salt brands lose more weight than lower salt brands. Kingsfood, with the lowest original salt content, lost the least amount of weight. Wikinger, the middling brand, lost the most amount of weight. The graphs indicate there could be a trend where low and high salt brands lose less weight overall. The most dramatic changes in weight come from the Wikinger (green) brand. As seen in in Figure 5 below, it loses 9.33g at day five but regains 6.33g by day ten. This trend of dramatic change continues into days 12 and 14, but levels out with the rest of the brands by day 16. Dino's (blue) follows a similar trend in dramatic change, steadying out at day 14. These two brands were the only two to contain stabilisers. Kingsfood (red) and Berlinki (purple) contained no stabilisers and follow a similar tend to one another, gaining and losing weight similarly throughout the experiment, though at different amounts. Herta, the only brand with a lactic acid culture, resembles the hot dogs with stabilisers more than those without. However, when factored into the total amount of loss of weight, there is little correlation between the pairs of brands mentioned above.

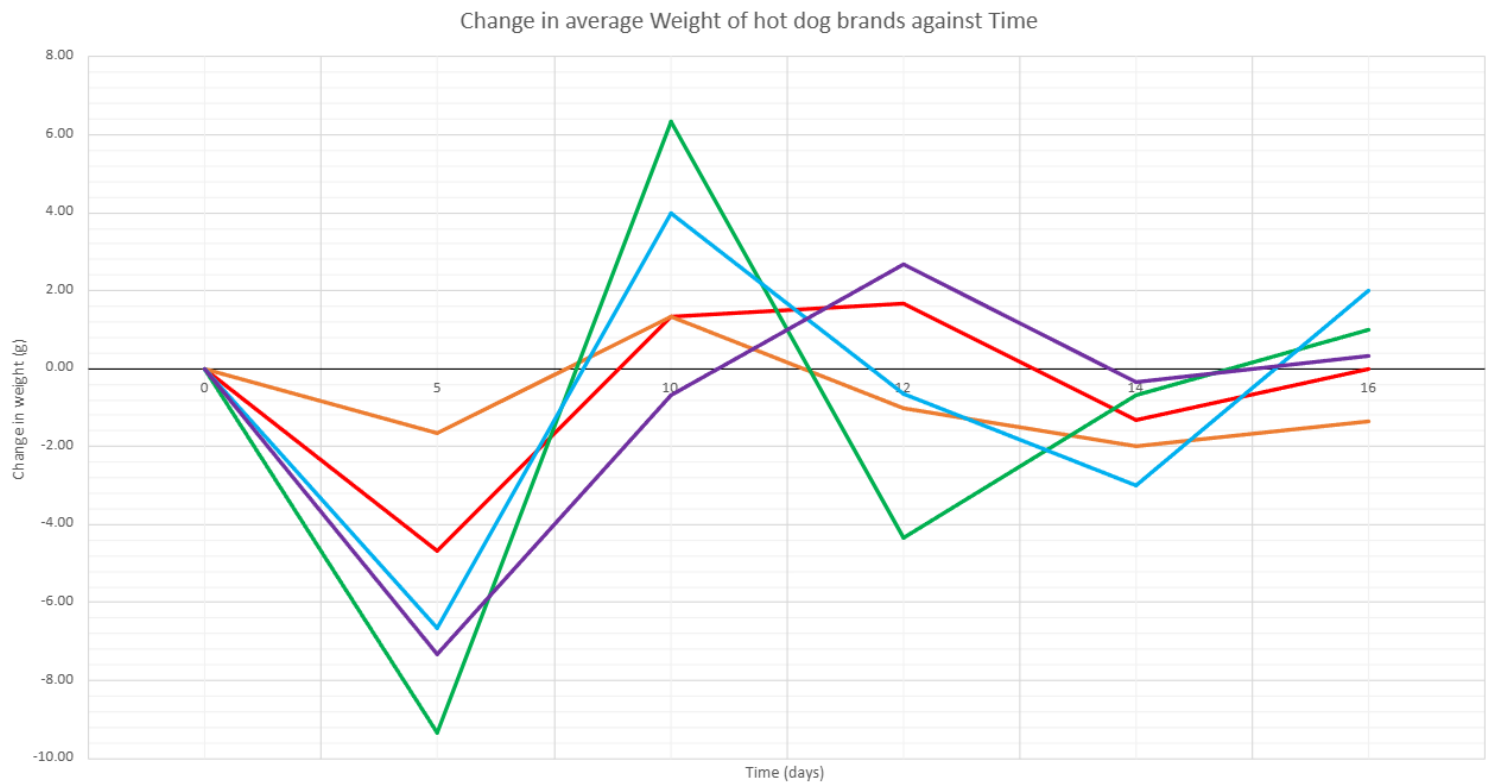


Figure 5. Line graph showing change in average Weight of hot dog brands against Time

Conclusion

The results shown are inconclusive regarding the hypothesis. There is some suggestion that the additives within the hot dogs impact their capacity to mummify, more than the initial salt content. This is shown by the similar trends of Wikinger (green) and Dino's (blue), which have similar additives and similar salt contents, at 0.4800g and 0.5040g respectively, and Kingsfood (red) and Berlinki (purple) that have no additives and very different salt contents, 0.2976g and 0.6000g. Such results that differ so widely from expectation could be explained by technical error, and too many uncontrolled variables. In an ideal experiment to test the effects of existing salt content, each hot dog would be the same aside from salt content. Factors such as the meat used, additives or lack thereof, and fat content would ideally remain the same across each hot dog. While existing salt content changed across each brand, the amount of water present within each hot dog due to additional factors also was different. This would affect the concentration gradient, therefore impacting the overall weight loss. Additionally, due to the difference in meat usage, the surface area of each hot dog was slightly different, shown by Figure 6, calculated using $2\pi r^2 + 2\pi rh$, where r is the estimated radius of the hot dog, and h is the estimated height of the hot dog. Measurements could be improved with the use of a calliper.

	Length (cm)	Radius (cm)	Surface Area (cm ²)
Kingsfood	9.20	0.75	46.89
Herta	9.80	0.75	49.72
Wikinger	7.70	0.80	42.73
Dino's	8.20	0.80	45.24
Berlinki	8.00	0.90	50.33

Figure 6. Table showing surface area of each hot dog brand at 24g.

Individually, there is no correlation between factors such as surface area, fat content (see Appendix 3), meat content, a weak correlation with additives, and the weight lost. However, combined, these factors could explain the large difference between expectation and the results in the experiment. If repeated in the future, a better set of scales with a higher resolution could be used, and measurements taken more frequently from the beginning of the experiment. Other factors, such as the additives, fat content, etc, cannot be controlled with these brands. Brands with more similarity in ingredients could be employed in future, provided availability. Additionally, more salt could have been used to reduce the chance of movement of water back into the hot dog and ideally reduce overall stickiness. Error while processing data could also impact results, therefore, having the results checked over by another person could assist. This experiment should also be done over a longer period with more specimens of each brand.

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Appendix 1: Percentage of meat content per hot dog.

	% Meat	Specific Meat
Kingsfood	62%	Mechanically separated chicken
Herta	75.60%	Pork
Wikinger	73%	Mechanically separated poultry (turkey, chicken), meat (pork, turkey, chicken)
Dino's	80%	Pork
Berlinki	71%	Pork, Chicken

Figure 7. Table showing the % meat and specific meat of each brand.

Appendix 2: Full results of measurements of weight of each hot dog brand.

	0 Days (g)		5 Days (g)				10 Days(g)				12 Days (g)					
		1	2	3	Av.	+ / -	1	2	3	Av.	+ / -	1	2	3	Av.	+ / -
Kingsfood	24.00	20.00	19.00	19.00	19.33	-4.67	21.00	20.00	21.00	20.67	1.34	23.00	22.00	22.00	22.33	1.66
Herta	24.00	22.00	22.00	23.00	22.33	-1.67	23.00	24.00	24.00	23.67	1.34	23.00	23.00	22.00	22.67	-1.00
Wikinger	24.00	15.00	14.00	15.00	14.67	-9.33	22.00	20.00	21.00	21.00	6.33	16.00	17.00	17.00	16.67	-4.33
Dino's	24.00	18.00	17.00	17.00	17.33	-6.67	21.00	22.00	21.00	21.33	4.00	20.00	21.00	21.00	20.67	-0.66
Berlinki	24.00	16.00	16.00	18.00	16.67	-7.33	16.00	16.00	16.00	16.00	-0.67	19.00	19.00	18.00	18.67	2.67
	14 Days (g)						16 Days (g)									
		1	2	3	Av.	+ / -	1	2	3	Av.	+ / -					
Kingsfood		21.00	21.00	21.00	21.00	-1.33	21.00	21.00	21.00	21.00	0.00					
Herta		21.00	20.00	21.00	20.67	-2.00	19.00	19.00	20.00	19.33	-1.34					
Wikinger		16.00	16.00	16.00	16.00	-0.67	17.00	17.00	17.00	17.00	1.00					
Dino's		18.00	17.00	18.00	17.67	-3.00	19.00	20.00	20.00	19.67	2.00					
Berlinki		18.00	18.00	19.00	18.33	-0.34	19.00	18.00	18.00	18.67	0.34					

Figure 8. Table showing full measurement data for Hot Dog weight

Above is each measurement taken to determine an average weight for the hot dog, to account for scale error. Three measurements were taken at a minimum. Additionally, the gain / loss between the taken measurement and the previous measurement is displayed, where green represents a gain in weight and red a loss. These gains and losses were used to calculate overall gain or loss for each brand from day 0 to day sixteen. An average gain and loss were also calculated.

Appendix 3: Fat content of each hot dog brand.

	Fat Content /100g	Fat Content /24g
Kingsfood	8.40	2.0160
Herta	23.50	5.6400
Wikinger	17.00	4.0800
Dino's	19.00	4.5600
Berlinki	18.00	4.3200

Figure 9. Table showing the fat content of each hot dog brand for 100g and 24g.