Salt and Torah

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Salt, the simple mixture between a metal and non-metal ion, has many applications in chemistry and Torah. Salt itself is very significant in Judaism. One of the earliest mentions of salt is when in ,ספר בראשית *אברהם* sent messengers to warn his nephew לוט of the destruction of סדום and עמורה, the city where *לוט* lived. *לוט* was instructed to leave the city with his family and to not look back on the destruction while they were running away. Evidently, as seen in בראשית,in *לוט*'s, wife looked back on the city.

וַתַּבֵּט אִשְׁתּוֹ מֵאַחֲרָיו וַתְּהִי נְצִיב מֶלַח: -a *לוט*'s wife looked back, and she thereupon turned into a pillar of salt. [1].

לוט's wife was turned into a pillar of salt. Many commentaries struggle with the meaning behind this phrase, and many have come to believe that she turned into a pillar of salt which spilled over into what is known today as the Dead Sea. Dr. Irving Myron Klotz, a highly respected Professor at Northwestern University, completed his Ph.D. in Physical Chemistry at the University of Chicago. He published numerous works, along with the paper "The chemical death of *לוט*'s wife: discussion paper." In this paper, Dr. Klotz wrote about the probability that the salt *לוט*'s wife turned into was calcite [2]. The formation of calcite, as seen below, precipitates from the reaction of $Ca^{2+}$and CO_3^{2-}. This reaction has a -11.38 kcal/mol free energy change, meaning that the formation of calcite is favored in this reaction. Furthermore, an increase in temperature and CO_2 pressure shifts this reaction towards the formation of calcite.

$$Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$$

The human body has many Ca^{2+}ions, intracellularly, extracellularly, and embedded within proteins and ligands. Dr. Klotz wrote that when *לוט*'s wife turned around, she exposed herself to the intense heat and CO_2 pressure coming from the burning city. That mix of chemicals and heat may have caused her body to precipitate calcite, thereby turning her into a pillar of salt [2].

While this story is the first instance of salt in the Torah, salt extends into many areas of Jewish tradition. The offerings brought in the בית המקדש were all brought with salt, and to remember this, there is a practice to dip bread on שבת into salt. ספר ויקרא stated that we must offer every *קרבן* with salt.

וְכָל־קָרְבָּן מִנְחָתְךָ֖ בַּמֶּ֣לַח תִּמְלָ֑ח וְלֹ֤א תַשְׁבִּית֙ מֶ֣לַח בְּרִ֣ית אֱלֹהֶ֔יךָ מֵעַ֖ל מִנְחָתֶ֑ךָ עַ֚ל כָּל־קָרְבָּנְךָ֣ תַּקְרִ֔יב מֶ֖לַח:

You shall season your every offering of meal with salt; you shall not omit from your meal offering the salt of your covenant with God; with all your offerings you must offer salt [3].

Rabbi Immanuel Bernstein commented on the significance of including salt with *קרבנות*. He wrote that one purpose of the salt on the *קרבן* is symbolically to preserve Judaism and to experience the בית המקדש. When one goes to the בית המקדש to bring an offering, he becomes inspired by what he sees. That

inspiration is meant to be spiritually preserved even when outside of the בית המקדש, just as salt is used for preservation [4].

Salt has dehydrating and antiseptic properties. Food has both “bound water” and “free water,” with bound water forming spheres of hydration around ions, and “free water” which is the bioavailable water for uptake by living organisms This relation between bound and free water is expressed as ‘water activity’. Regarding microbial spoilage of food, it is the amount of bioavailable free water that mediates growth of contaminating bacteria and fungi. Before the invention of the refrigerator, salt was used to preserve food from spoilage. Even now, packaged foods have a high sodium concentration that allows them to stay fresh for a long time without refrigeration. Salt on food has the ability to inhibit microbial growth by reducing the amount of free water in the food. As salt influences osmotic pressure, some microorganisms die from osmotic shock, with the osmotic movement of water from within the cells to the higher concentration of salt in the surroundings. A high salt concentration also limits oxygen solubility in cells and thereby interferes with microbial growth [5, 6].

The ספר החינוך offered another explanation for why salt is added to *קרבנות*. Salt enhances the flavor of food. One way that salt has the ability to improve taste is by the suppression of bitter compounds in food. Sodium in salt reacts with bitter-tasting compounds causing the overall taste of food to improve. Studies have shown that the addition of sodium to a mixture of sugar and urea increased the sweetness of the mixture. Furthermore, when tested as a mixture of sodium and sugar alone, no difference in sweetness was detected. This showed that sodium decreased the bitterness of food by suppressing bitter tasting chemicals [7]. Another way that salt enhances the flavor of food is by reducing the water activity of foods. By reducing the amount of bioavailable water, the flavors of food are more concentrated, resulting in a tastier meal [8]. When bringing a *קרבן*, the person is supposed to bring it with flavor, *i.e.,* meaning that the bringing of the *קרבן* should be with a purposeful intention. The ספר החינוך explained that just like it would be inappropriate to serve a prominent individual food lacking flavor, it would be inappropriate to bring a sacrifice without meaning and sincerity [9].

In conclusion, the properties of salt enhance everyday life. Both scientifically and spiritually, salt gives us the ability to add flavor and reduce bitterness in our lives. The properties of salt allow for the preservation of both food and Judaism.

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