Derech HaTeva

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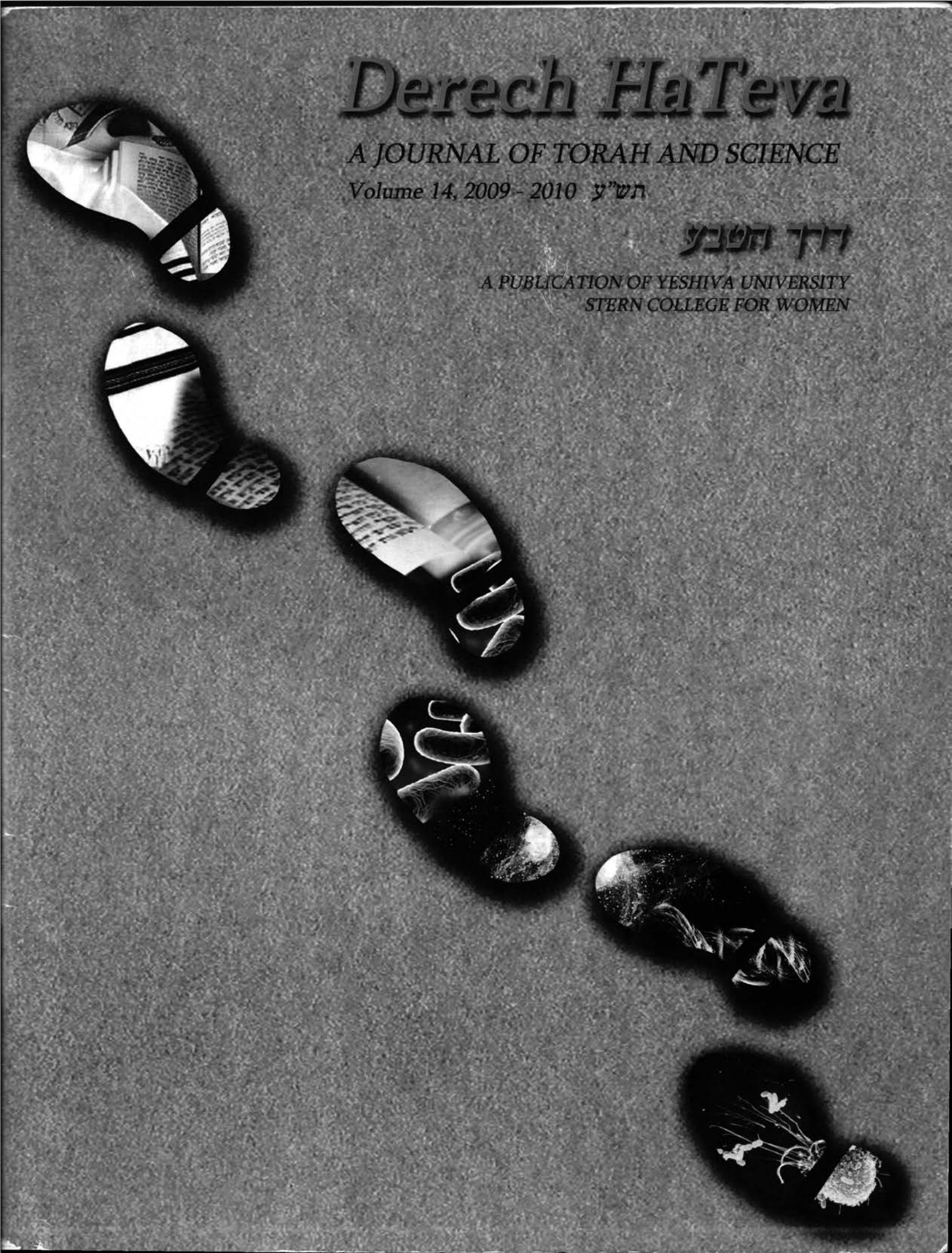
A PUBLICATION OF YESHIVA UNIVERSITY
STERN COLLEGE FOR WOMEN



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DEDICATION & ACKNOWLEDGEMENTS

We dedicate the fourteenth publication of Derech HaTeva to the memory of Rabbi Pesach Oratz, Z"L. Rabbi Oratz was an unassuming, yet foundational pillar of Yeshiva University. He lived, breathed, and embodied the words of the Torah, radiating its light to those who merited knowing him.

Born in the Lower East Side of Manhattan, Rabbi Oratz attended MTA high school and thereafter received a B.A. with a major in English from Yeshiva College. He continued his education at Bernard Revel Graduate School and received his smicha from RIETS. Already beginning in his early teens, he dedicated his life to the teaching of Torah. In addition to his position at Stern College for Women, which he held for over thirty years, Rabbi Oratz was on the faculty of Shulamith High School for Girls, Camp Morasha, and several other schools, as well. In his lifetime, he undoubtedly learned Torah with tens of thousands of students. His uniquely soft-spoken, yet passionate tone delivered the Torah's messages in a way that penetrated his listeners' hearts and minds. Rabbi Oratz passed away on September 9, 2009, leaving an eternal legacy to his family, colleagues, and students.

"Rabbi Oratz (Z"L) used the wealth of his Torah knowledge to enhance the lives of thousands of students. His abiding interest in helping them grow both in content and in values was evident in the personal relationship he established with them and from his well earned reputation of being able to communicate with everyone - young and old, beginners and advanced. We were blessed to have had him as a member of the Jewish Studies faculty of Stern College for Women, and he will always be remembered."- Karen Bacon, Ph.D., The Dr. Monique C. Katz Dean

We present this volume of Derech HaTeva in his honor and memory.

THE EDITORS

Ariella Hollander Esty Krausz Emily Liebling

PASUK

ה' בחכמה יסד ארץ כונן שמים בתבונה
משלי ג:י"ט

G-d founded the land with wisdom; He established the heavens with understanding
(Proverbs 3:19)

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P'RU UR'VU AFTER DEATH

Ashley Ansel

The scene is a sad one; a father is killed in a tragic accident, leaving behind his wife and four young daughters. The young widow looks at her daughters lovingly, remembering, before her first daughter was born, how hard it was for she and her husband to conceive. As they had both wanted a son, she decides to ask an *in vitro* fertilization (IVF) physician to obtain her dead husband's sperm to enable her to conceive a son. We will walk with her as she embarks on this journey, trying to answer some of the questions that she will encounter on the way.

Is she allowed, according to *halakha*, to use in vitro fertilization (IVF)? *In vitro* fertilization uses the spermatozoa (sperm cells) from the male partner and the ova (eggs) from the female partner. These ova are fertilized in the laboratory to form pre-embryos, which are implanted into the woman who will carry and deliver the baby. The primary issue that was first addressed regarding IVF, was of *hashchatat zerah*, the wasting of "seed." To collect sperm cells from the male contributor, the sperm must be emitted in a manner normally prohibited on the grounds of *hashchatat zerah*. Many *Poskim* (Rav Shalom Schwadron, Rav Aharon Walkin, Rav Moshe Feinstein, Rav Shlomo Z. Auerbach, and Rav Ovadia Yosef) "permitted IVF on the basis that emission of sperm for the purpose of producing a child does not constitute violation of the prohibition of *hashchatat zerah*" [1].

The subsequent question is whether the father fulfills his obligation of the *mitzvah* of *P'ru Ur'vu* by using IVF. According to Rav Yehoshua Baumohl and Rav Yitzchak Weiss, "If a man were to contribute spermatozoa for the purpose of producing a child, as is the case in... IVF, the *mitzvah* [(of *P'ru Ur'vu*] would certainly be fulfilled" [1]. Other *poskim* (Rav Mordechai Willig and Rav Yaakov Breisch) are of the opinion that the couple does not fulfill the mitzvah of *P'ru Ur'vu* through IVF [2]. *Shulchan Aruch, Even HaEzer* 1:5, clearly states, "One is not in fulfillment of this *mitzvah* until one bears a son and a daughter" [1]. Did the deceased father of four daughters fulfill the *mitzvah* of *P'ru Ur'vu*? Will this *mitzvah* be fulfilled if the widow uses his frozen sperm to have a son?

SUPPOSE THAT SHE WAS ALLOWED TO USE IVF TO HAVE ANOTHER CHILD, WOULD SHE BE PERMITTED TO SELECT ONLY THE MALE EMBRYOS FOR IMPLANTATION?

Let us begin by analyzing the commandment of *P'ru Ur'vu*. According to Rav Moshe Feinstein, the *mitzvah* of *P'ru Ur'vu* is not result oriented. "The *ma'aseh hamitzvah*, the action demanded by the *mitzvah*, is to perform marital relations. The action itself is the fulfillment of the *mitzvah*. The requirement that one bear a boy and a girl does not address the fulfillment of the *mitzvah*. Assuming that the *mitzvah* of *P'ru Ur'vu* is action oriented, there is no added fulfillment of the mitzvah of *P'ru Ur'vu* by employing IVF." *Knesset HaGedolah, Even HaEzer*, adds an interesting layer to our situation by stating that, "If one's progeny are all of the same gender, and one of those children gives birth to a child of the opposite gender, one is in fulfillment of the *mitzvah* [*P'ru Ur'vu*]" [1]. This would indicate that if one of this man's daughters eventually gives birth to a son, then he will have fulfilled the *mitzvah* of *P'ru Ur'vu*. Additionally, Rav Eliezer Waldenberg and Rav Yitzchak Weiss rule that, "The permissibility of IVF was limited to those who have difficulty bearing children" [1]. This ruling would seem to imply that the woman in our scenario, who already has children, may not use this biomedical technology to conceive again. Finally, according to Rav Yaakov Ariel, "There is no obligation to fulfill the *mitzvah* of *P'ru Ur'vu* by artificial means. And if one was blessed by *Hashem* with only one son, then that is G-d's will" [4].

Suppose that she was allowed to use IVF to have another

child, would she be permitted to select only the male embryos for implantation?

Modern technological advances allow people to choose the gender of their child at levels of accuracy never previously witnessed. Two of these methods are: pre-implantation genetic diagnosis (PGD) and the flow cytometry separation (FCS) method (which is patented and registered under the name MicroSort® and will be referred to as the MicroSort method for the remainder of this article). The PGD method uses IVF. The pre-embryos cultivated in the laboratory can be diagnosed for various genetic features, including their impending gender. The desired embryos are then selected and implanted into the woman who will carry and deliver the baby. The accuracy of the PGD method is near perfect, subject primarily to human error. The MicroSort method attempts to sort the spermatozoa based on the fact that X-bearing sperm have 2.8% more DNA. A fluorescent dye is applied to the sperm which are passed through a flow cytometer. The flow cytometer measures the amount of fluorescent light emitted by the DNA. The X- chromosome-bearing sperm containing more DNA will emit more light than the Y chromosome-bearing sperm. The flow cytometer can then separate the X- chromosome bearing sperm from the Y-chromosome bearing sperm. The desired spermatozoa are then used to fertilize the ova using IVF technology. The accuracy of the MicroSort method can be as high as 93% [1].

The issue of gender selection in *halakha* is very complicated, yet we will try to navigate through a few of the sources that deal with the subject. Rav Yitzhak Zilberstein stated that the rabbinic judgment to produce a baby of a desired sex is simply too frivolous a *halakhic* concern, yet "in the case of a serious genetic disease which affects the couple, it is difficult to forbid the suggestion [for genetic screening through IVF]" [3]. Rav Moshe Feinstein wrote that "there might be a prohibition of using medical treatments for non-medicinal purposes" [1]. Based on his ruling it would be prohibited to use IVF for non-medicinal purposes, such as gender selection. According to Rav Ovadia Yosef, however, "PGD for sex selection could be used by a couple who had six children of one sex and who would not have any more children unless they were sure that the seventh would be of the opposite sex." Rav Mordechai Eliyahu "permitted sex selection for a couple who had five children of the same sex." Sephardic Chief Rabbi, Rav Shlomo Amar, "permitted PGD for genetic reasons, as well as for *P'ru Ur'vu* and *shalom bayit*." Similarly, Rav Dov Leor allowed PGD for medical reasons and also granted permission if the couple already had three sons (which creates a *hazaka* that only sons will be born in the future) and the parents wanted a daughter [4]. According to these last few opinions, it seems as though the wife would be allowed to select a male embryo.

Let us suppose that the woman was allowed to go as far as the selection of a male embryo for implantation. Would this boy have a *halakhic* relationship with the father? The vast majority of *poskim* view IVF as an appropriate method of overcoming a fertility problem. As such, the overriding consensus is that the relationship between the genetic father and a child conceived via IVF is identical to that between a father and a child conceived by natural means. What if the insemination is performed after the father's death? Does this change the *halakhic* status of the child? The late Rabbi Shaul Yisraeli ruled that, "A child conceived through posthumous insemination or implantation has no *halakhic* father" [6]. This indicates that the child would not inherit his genetic father's material estate, nor his status as a *Cohen* or *Levi*. According to Rav Israeli, if a widow becomes pregnant through IVF after her husband dies and subsequently gives birth, her deceased husband is considered to have fulfilled the mitzvah of *P'ru Ur'vu*. Despite the lack of conclusive proof as to whether the child and father are *halakhically* related, this ruling suggests that, indeed, they are. Now we come to the last most pressing question, which was touched upon previously: is this woman allowed to use the sperm of her deceased husband? A potential *issur* that has to be dealt with is the prohibition of *nivvul ha-met*, insulting the dignity of the dead, which is considered to be a type of damage. We learn from the Oral Torah that the source of the prohibition against causing damage to another person is *lo tigzol*, "You shall not steal" (*Vayikra* 19:13). It can be argued, however, that the procedure does not involve insult to the deceased person's dignity. Furthermore, postmortem sperm retrieval seems to fall under the prohibition of *hana'a min ha-met*, deriving benefit from a corpse. Because procreation is a mitzvah, however, the prohibition of *hana'a min ha-met* should not apply. The benefit of performing a mitzvah and fulfilling G-d's command is not considered a forbidden *hana'a* (*Eiruvin* 31a). When Rabbi Zalman Nehemia Goldberg was asked by the Israeli Surrogacy Committee if *halakha* permits the removal of semen from a deceased man for his widow to bear his child, he answered, "Without the man's consent it is, or course, forbidden. However, if he gave explicit consent to postmortem sperm retrieval or if it is clearly known that he would have wanted the procedure done, then there is no prohibition against performing postmortem sperm retrieval" [5]. Despite this ruling, most opinions hold that one cannot fulfill a mitzvah post-mortem [7], as it states in the *passuk*,

"*lo hameitim yehallelu ya*, neither the dead shall praise G-d" (*Psalms* 115:17).

In conclusion, it must be emphasized that nothing stated in this article should be viewed as a *psak halakha* regarding IVF or any other *halakhic* matter. My intent is to introduce how complicated these cases are and how much thought and deliberation go into answering each question that arises.

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I would like to thank my parents for being such exceptional role models and for supporting me in all of my endeavors, Rabbi Gideon Weitzman Director of Machon Puah Jerusalem for reviewing the *halakhic* content of this article, and Dr. Babich for all of his help in the completion of this article.

REFERENCES

[1] Flug, J. (2004). A boy or A girl? The ethics of preconception gender selection. J. Halacha Contemp. Soc. 47: 5-27.

[2] Rabbi Gideon Weitzman, personal communications.

[3] Grazi, R.V., Wolowelsky, J.B. and Jewelewicz, R. (1994). Assisted reproduction in contemporary Jewish law and ethics. Gynecol. Obstet. Invest. 37:217-225

[4] Wolowelsky, J.B. and Grazi, R.V.(2007). Sex selection and *halakhic* ethics: A contemporary discussion. Tradition. 40:45-78

[5] Halperin, M. (2001). Post-mortem sperm retrieval. Jew. Med. Ethics 4:9-13

[6] Grazi, R.V. and Wolowelsky, J.B.(2001). Parenthood from the grave. The Jewish Spectator. 65:4

[7] Weitzman, G. (2004). *Lekichat Zera Mi'baal mechoser hakara.* Techumin 25. 59-63

LAND FLOWING WITH HONEY: AMAZING HEALTH BENEFITS FOR ITS PEOPLE

Fay Burekhovich

When one contemplates the properties of honey, its considerably high sugar content likely stands out from among its other properties. The Philistines who stealthily received the answer to Shimshon's posed riddle certainly knew this, and in their interpretation of "from the strong comes sweet" as an allusion to honey, they essentially claimed that nothing sweeter than honey exists (Judges 14:14-18). Although this may repel people who care for the well-being of their teeth, health benefits for the honey eater abound and should be taken into serious consideration. Not only has honey been associated with a myriad of positive qualities already in the Torah, but also research has consistently shown the superior caliber of this food.

The *Tanakh* makes frequent mention of honey. Possibly the most well-known phrase in the Torah relating to this food is the one that refers to Israel as a "land flowing with milk and honey" (e.g., Exodus 3:8; 33:3). This rich metaphorical image underscores the fruitfulness and bountiful nature of foods in the land of Israel. Thus, this usage of honey, which occurs many times in the Torah, is surely associated with positive connotations. Also important in helping us understand the nature of honey in the Torah is the description of the manna, the food that fell from the heavens while the Jews were in the desert, regarding which the Torah states that it tasted much like a *tzapichit bidvash* (Exodus 16:31). Rashi translated this phrase to mean a kind of dough that is fried in honey. It seems, therefore, that this miracle food, which satiated the Jewish nation on a daily basis and allowed them to comfortably subsist throughout their long sojourn in the desert, bespeaks wonders about the makeup of honey: This food likely possesses the requisite nutritive qualities for a nation to live and grow.

An account of honey also appears in I Samuel, which recounts how King Shaul, in an effort to defeat Israel's enemies more quickly, declared a fast for all soldiers until the next morning. Verse 27 (I Samuel 14) describes how Yonatan, unaware of the fast and weary from spending a day in battle, immediately lights up after consuming honey in a forest overflowing with it. Upon finding out about the decree from his fellow soldiers, Yonatan decries his father's action and conveys how his eyes lit up after ingesting only a scant amount of the food. He claims that the soldiers would have succeeded to a greater degree against their enemies had they only been allowed to eat (I Samuel 14:24-30).

RASHI REMARKED THAT PEOPLE CUSTOMARILY RUBBED HONEY ONTO ABRASIONS ON THE BACK OF HANDS AND LEGS AS WELL AS ONTO BLISTERS THAT FORMED ON THE BACKS OF HORSES AND CAMELS AS A RESULT OF THEIR HEAVY LOADS.

(SHABBAT 76B)

The beneficial properties of honey stem from its source: dates. In Biblical times, honey was made from dates, notable for their nutritiousness and salubrity [1]. The Talmud lists several properties of dates, which include satiating, warming up, and strengthening the eater (*Ketubot* 10b; *Gittin* 70a). These properties accord with the fact that the manna sustained the Jews, for eating it seems to have involved the consumption of date honey. Beyond satisfying the eater, dates are also advantageous for eliminating ailments of the bowels and hemorrhoids (*Ketubot* 10b; *Gittin* 70a). Additionally, a woman in postpartum who has eaten dates does not need to drink warm water on the Sabbath, and thus, warming up water for her is prohibited (*Eruvim* 68a). Here, too, dates confer benefits to its consumer, much like the comfort a debilitated individual receives from drinking heated water.

The views presented in the Jewish literature correspond to scientific research regarding the biochemical and nutritional properties of dates. In their article on dates, Al-Shahib and Marshall [2] suggested that "dates may be considered an almost ideal food." To begin with, dates contain at least six vitamins and 15 minerals, including vitamins A, B1, B2, and C and calcium, iron, magnesium, and potassium. In addition, elemental fluorine, which protects against tooth decay, is present in this food. With respect to dietary fiber, a significant amount (roughly 6-11%) exists [2] in both the flesh and the seed, with the major portion of the fiber occurring in the insoluble form [3]. Date flesh is high in sugar and energy, and low in fat. The seed, however, consists of a greater variety and higher percentage of fats as compared to the flesh. Depending on the variety of date, the seed contains between 41.1-58.8% oleic acid; thus, the seed provides an exceptional source of this unsaturated fatty acid. The protein in dates comprises 23 amino acids. These include some not present in more popular fruits, such as apples and oranges. Dates also contain selenium, required by the body in trace amounts and believed to play an instrumental role in immune function and prevention of cancer [2].

Moreover, dates demonstrate antioxidant potential, which, given the aforementioned remarkable qualities of this food, should come as no surprise. Both the flesh and the seed are excellent sources of antioxidants, mainly in the form of carotenoids and phenolic compounds [3], which exist in various forms across a wide range of plants [4]. It must be noted, however, that dates lose a certain portion of antioxidants and all anthocyanins after being dried in the sun [5]. Another hallmark of dates is the presence of beta-glucan, which was "found to exhibit potent antitumor activity," possibly due to the (1 → 3)-beta-D-glucan linkages [6]. The study of Ishurd *et al.* [6] involved implanting sarcoma-180 solid tumors into mice and injecting them with beta-glucan. Results indicated both an inhibition of tumor growth and a regression in total tumor size after 30 days.

In their work investigating the effects of date consumption by healthy individuals, Rock *et al.* [7] showed that Medjool and Hallawi varieties of dates possess ferric reducing antioxidant power (FRAP), as well as free radical scavenging capabilities. They attributed their outcomes to an array of phenolic compounds, such as ferulic and coumaric acids contained in the dates. They also acknowledged that the unique composition of sugars in dates may have contributed to the FRAP data, as the sugar fraction isolated from dates engendered the highest FRAP activity when compared to all other refined sugars. In addition, the authors reported "reduced serum triacylgycerol levels," most likely affected by the high percentage of dietary fiber in dates, as well as maintenance of serum glucose levels in these healthy subjects. Equipped with this knowledge, one may reasonably conclude that Jewish sources and scientific research coincide.

The honey we eat today comes from bees. The formation of this honey commences with worker bees, which collect nectar from various flowers, such as clovers, and store it in a bodily cavity termed the honey sac [8]. Upon returning to their hive, they pass the nectar to other bees, which then spit it out into the honeycomb and fan it with their wings in order to remove most of the water from the nectar [9]. This concentrates the nectar [8]. While this occurs, enzymes in the bees' saliva invert sucrose, the primary sugar in nectar, into glucose and fructose. Enzymes are also responsible for creating an acid that repulses most bacteria; this aids in the long-lasting storage of honey [9].

Although the general rule holds that food items derived from impure sources are not kosher, all agree that honey is exempt from this prohibition. The Talmud provides two reasons: According to the first one, honey may be eaten because it is simply reprocessed nectar that was spit out of bees, and not an actual excretion of the insect; the second reason indicates that bee-derived honey receives kosher status only because of a *g'zeirat ha'katuv,* a special Biblical allowance. Practical ramifications between the two explanations come into play when considering honey that comes from insects other than bees. According to the first reason, if honey from other insects is merely converted nectar, then the honey should be kosher. Following the second reason, however, honey obtained from other non-kosher insects should be effectively excluded [8].

The Talmud discusses a number of benefits associated with honey. For example, honey was used as an ointment to treat sores (e.g., *Shabbat* 76b, 77b). Rashi remarked that people customarily rubbed honey onto abrasions on the back of hands and legs as well as onto blisters that formed on the backs of horses and camels as a result of their heavy loads (*Shabbat* 76b). Thus, people utilized honey for therapeutic purposes. Apparently, honey also effected positive change in one's eyesight, much like the case of Yonatan during battle, and honey consumed after a meal was considered salutary for one's vision (*Yoma* 83b). Furthermore, for a person afflicted with the serious condition known as *bulmos*, characterized by a loss in ability to see and occurring because of hunger, health was restored by providing the patient with honey (and other sweets), because this food improves a person's vision (*Yoma* 83a, 84b).

Modern scientific research on the biochemical properties of bee honey provides compelling support for the palliative and curative uses of honey presented in the Talmud. Beretta et al. [10] noted that the use of honey as a dressing for wounds is predicated upon three factors: 1) its "peroxide-dependent antibacterial activity;" 2) the presence of various antiinflammatory agents; and 3) "the possibility that kynurenic acid, a tryptophan metabolite antagonist for glutamate receptors, might have antinociceptive action on injured tissue by antagonizing NMDA [N-methyl-D-aspartate] at peripheral GABA receptors." They showed that chestnut honey possesses pain-reducing qualities due to its quinoline alkaloids; that herbal honey contains antiinflammatory constituents; and that both the antinociceptive and antiinflammatory properties act in tandem with the antibacterial action present in all honeys to aid in the healing of dermatological lesions.

In a clinical trial, Jull *et al.* [11] related that honey used in dressings may decrease healing times in relatively mild to moderate burns as compared to dressings of the more traditional type. In addition, honey samples were found to have antibacterial effects against *Staphylococcus aureus* [12]. Khan *et al.* [13] went so far as to advocate for the use of honey in surgical procedures and to advise the patient to request to use honey in the treatment of postoperative wounds. They also asserted that: infection never results from placing honey on wounds; honey may play a role in treating gum disease; honey offers an alternative treatment for those affected by ophthalmic ailments; and resistance of bacteria to antibiotics has sparked renewed interest in honey as an effective antibiotic and wound healing agent. The properties of honey that confer such exceptional antibacterial qualities are its acidic environment (due to the presence of gluconic acid), low moisture levels, high sugar content, and the presence of hydrogen peroxide.

Jaganathan and Mandal [14] described the antiproliferative effects of honey in relation to its role in arresting colon cancer cells in the subG1 phase of the cell cycle. They proposed that honey induces apoptosis via generation of reactive oxygen species and "mitochondria-dependent mechanisms," and concluded that honey acts as a potentially potent chemotherapeutic agent against colon cancer. In addition, they observed that many polyphenols present in honey, such as caffeic acid, chrysin, and quercetin, show promise in cancer treatment. Quercetin, for example, has been shown to promote antiproliferative effects against gliomas and breast cancer cells [4]. Schramm *et al.* [15] documented the bioavailability of phenolic antioxidants in processed honey as well as the increased levels of plasma antioxidant activity following consumption of the substance. Going one step further, they recommended utilization of honey as an alternative to refined sugar; this, they claimed, "could result in an enhanced antioxidant defense system in healthy adults." In a study involving the long-term replacement of sucrose with antioxidant-rich honey in the diet of middle-aged rats, Chepulis *et al.* [16] discovered that honey aids in the maintenance of brain function: Rats fed with honey displayed decreased anxiety and increased spatial memory capabilities.

Thus, irrespective of honey's source, be it from dates or from bees, modern-day science corroborates the accounts of honey in the Torah. The believing Jew will likely not be surprised at this result, seeing the plethora of proven health benefits in honey as the figurative hand of G-d performing wonders. One who truly internalizes this belief will incorporate more honey into the diet, much to the approval of honey researchers and honey marketers alike.

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REFERENCES

[1] Ba-Gad, J. (1985). Dietetic and medicinal use of dates according to the sages of the Talmud. Koroth, 9:84-85.

[2] Al-Shahib, W. and Marshall, R.J. (2003). The fruit of the date palm: its possible use as the best food for the future? Int. J. Food Sci. Nutr. 54:247-259.

[3] Al-Farsi, M.A. and Lee, C.Y. (2008). Nutritional and functional properties of dates: a review. Crit. Rev. Food Sci. Nutr. 48:877-887.

[4] Jaganathan, S.K. and Mandal, M. (2009). Antiproliferative effects of honey and of its polyphenols: a review. J. Biomed. Biotechnol. 2009:1-13.

[5] Al-Farsi, M., Alasalvar, C., Morris, A., Baron, M., and Shahidi, F. (2005). Comparison of antioxidant activity, anythocyanins, carotenoids, and phenolics of three native fresh and sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. J. Agric. Food Chem. 53:7592-7299.

[6] Ishurd, O., Zgheel, F., Kermagi, A., Flefla, M., and Elmabruk, M. (2004). Antitumor activity of beta-D-glucan from Libyan dates. J. Med. Food. 7:252-255.

[7] Rock, W., Rosenblat, M., Borochov-Neori, H., Volkova, N., Judeinstein, S., Elias, M., and Aviram, M. (2009). Effects of date (*Phoenix dactylifera* L, Medjool or Hallawi variety) consumption by healthy subjects on serum glucose and lipid levels and on serum oxidative status: a pilot study. J. Agric. Food Chem. 57:8010-8017.

[8] Blech, Z.Y. (2004). Kosher Food Production. Blackwell Publ. Ames, Iowa.

[9] Bistricer, D. The Kashrus of Honey. Hamodia 16 Sept. 2009:6-7.

[10] Beretta, G., Artali, R., Caneva, E., Orlandini, S., Centini, M., and Facino, R.M. (2009). Quinoline alkaloids in honey: further analytical (HPLC-DAD-ESI-MS, multidimensional diffusion-ordered NMR spectroscopy), theoretical and chemometric studies. J. Pharm. Biomed. Anal. 50: 432-439.

[11] Jull, A.B., Rodgers, A., and Walker, N. (2009). Honey as a topical treatment for wounds. Cochrane Database Syst. Rev. 2009:1-49.

[12] Miorin, P.L., Levy Junior, N.C., Custodio, A.R., Bretz, W.A., and Marcucci, M.C. (2003). Antibacterial activity of honey and propolis from *Apis mellifera* and *Tetragonisca angustula* against *Staphylococcus aureus*. J. Appl. Microbiol. 95:913-920.

[13] Khan, F.R., Ul Abadin, Z., and Rauf, N. (2007). Honey: nutritional and medicinal value. Int. J. Clin. Pract. 61:1705-1707.

[14] Jaganathan, S.K. and Mandal, M. (2009). Involvement of non-protein thiols, mitochondrial dysfunction, reactive oxygen species and p53 in honey-induced apoptosis. Invest. New Drugs. 2009:1-10.

[15] Schramm, D.D., Karim, M., Schrader, H.R., Holt, R.R, Cardetti, M., and Keen, C.L. (2003). Honey with high levels of antioxidants can provide protection to healthy human subjects. J. Agric. Food Chem. 51:1732-1735.

[16] Chepulis, L.M., Starkey, N.J., Waas, J.R., and Molan, P.C. (2009). The effects of long-term honey, sucrose or sugar-free diets on memory and anxiety in rats. Physiol. Behav. 97:359-368.

FATHERHOOD AFTER DEATH: A BIOLOGICAL AND HALACHIC ANALYSIS

Jennifer Deluty

The importance of carrying on a Jewish legacy and a paternal namesake is of utmost significance in Jewish law. The most prominent example of this idea is the *halacha* of levirate marriage, or *yibbum*. The biblical command dictates that the brother of a childless deceased man has a legal obligation to marry his brother's widow. The son that they bear will have the same lineage and namesake as that of the deceased, thus serving to continue the dead man's heritage. The verse explicitly states that the purpose for the implementation of such a law is "that his name (of the deceased) be not blotted out of Israel" (Deuteronomy 25:5). Continual scientific breakthroughs of the 21st century have revolutionized a new method by which a man's legacy can be continued post-mortem. Harvesting sperm immediately after death allows for the possibility of later inseminating a woman. Thus, husband and wife can successfully conceive even after his death. The science behind the procedure is not very complex, but the ethical and *halachic* ramifications are startling. It is clear that continuing the Jewish name is essential to Jewish life but can it be done in this innovative manner? The procedure could revolutionize bringing children to infertile cancer patients, dead war heroes, and victims of unfortunate accidents. But questions remain: Is taking the sperm permissible from a *halachic* standpoint? Does the sperm donor gain full paternal rights?

A case study published in a 2005 scientific journal presents a true case studied at the Centre for Assisted Reproduction, Department of Obstetrics and Gynecology, in the Czech Republic. From the first post-mortem sperm fertilization in 1980 to 1995, there were over eighty two cases worldwide. Dostal *et al.* [1] reported that, "Post-mortem sperm retrieval and its utilization in assisted reproduction techniques is now performed worldwide albeit with differences in national culture, ethical values, and legislation creating *de facto* divergences." The majority of countries agreed that without written consent from the deceased, this procedure presents major ethical concerns. The case study presented was unique in that there was prior documented informed consent and that it was relatively simple: in March 2002, a fatal accident at Prostejov airport in the Czech Republic caused the death of a 29 year old Hungarian parachutist. Three days after his death and on the second day after the autopsy, the parents of the deceased contacted the Institute of Forensic Medicine, through the Hungarian Consulate, and requested sperm retrieval from the deceased. A copy of his informed consent, sent through the Consulate, contained the request that in the event of his death, his sperm was to be retrieved and used for insemination of his partner. The procedure for sperm retrieval involved the removal of his testis by a forensic pathologist. The harvested sperm was mixed in a ratio of 1:1 with Medicult sperm freezing medium. The freezing medium/semen mixture was stored at room temperature for 10 min and then distributed into cryopreservation vials. The vials were suspended for a half hour over liquid nitrogen and then submerged into it for final storage at a temperature of -196°C [1].

THE PROCEDURE COULD REVOLUTIONIZE BRINGING CHILDREN TO INFERTILE CANCER PATIENTS, DEAD WAR HEROES, AND VICTIMS OF UNFORTUNATE ACCIDENTS.

The first step, cryopreservation, or the freezing of sperm, is sometimes permitted for a (living) married man who uses it to fulfill his obligation to procreate. Former Chief Rabbi of Israel, Eliyahu Bakshi Doron, only permitted this option for a married man with the *halachic* obligation to have children, while other *poskim*, like Rav Zalman Nechemya Goldberg, did not see a distinction between the married and the unmarried man, stating that they both have the obligation to procreate, thereby leaving the possibility for a single chemo-

therapy patient to undergo this procedure [2].

Even so, both views must be analyzed in a post-mortem sperm retrieval case with the new *halachic* problem of *nivul hamet*, or defiling the dead. In Jewish law, the deceased have certain rights and the defilement of their body is prohibited. There are serious implications of this prohibition, as the Talmud categorizes anything that would be damaging to a person's body during life as a prohibited act in death. *Nivul hamet* in the context of sperm retrieval is included in the category of *gezel*, or stealing from the dead. Consequently, it should be prohibited. However, Torah authorities like Rav Moshe Feinstein, admitted that the procedure is not painful or insulting to dignity and it is compared to a simple biopsy that would be permissible to perform on a living person [3]. In addition, there is overwhelming evidence that this procedure would completely violate the prohibition of *nivul hamet* if there was no prior explicit or implicit consent from the deceased. There is an additional question regarding the issue of *ha-na'a min hamet*, deriving benefit from the dead. Two *halachic* principles are cited to explain why this prohibition is not problematic in the post-mortem case. First, the Talmud, *Eruvin* (31a), notes the principle of *mitsvot lav lehanot nittenu*, or "*mitvzot* are not meant to derive benefit from." In other words, since the retrieval of sperm in this case is done in the act of doing a mitzvah, it is not considered *h'anaa*, or receiving benefit. In addition, Rabbi Issar Yehuda Unterman's argument with regard to cornea transplants is that since the cornea continues to live in the other person, it is not even considered dead tissue and thus may be used [3]. This argument may also be applicable in this situation.

In terms of the status of fulfilling one's obligation to procreate, many *halachic* authorities claim that the command of *peru u'revu*, "be fruitful and multiply," only encompasses natural conception and does not include artificial intervention. It seems, therefore, that the father cannot fulfill the *halachic* obligation to have children post-mortem [2]. However, the *Beit Shmuel* in *Even Haezer* (1:10) states that even if a man was asleep and inseminated a woman who subsequently gave birth, he is considered the father. Even according to the *Beit Shmuel*, one must ask if this obligation can be fulfilled after death. The *Minchat Chinuch* rules that in a case where the father dies, leaving a pregnant wife, the father has fulfilled his obligation for *peru urevu* through the birth of this child. This position stems from the *Minchat Chinuch's* position that the *kiyum*, or fulfillment, of *peru urevu* is the existence of children and not the maaseh, or act of the *mitzvah* itself [3].

The current law of the United Kingdom listed under the Human Fertilization and Embryology Act states that, "where the sperm of man, or any embryo, the creation of which was brought about with his sperm that was used after his death, he is not to be treated as the father of the child." Using a similar legal construct, the United States' Uniform Status of Children of Assisted Conception Act states the same conclusion. In the *halachic* realm, Rabbi Shaul Yisraeli notes that in this case, there is no *halachic* father. This position is precedented in both the case of a child born to a Jewish woman and a gentile man and the case of a convert who must sever ties with his family. Similar to post-mortem sperm donation, there is no *halachic* father in either of the situations [3]. However, it must be noted that there is a big difference between uncertainty in the realm of paternity and that of an unknown father. In this case, the biological father is known but the paternity is unknown from a legal *halachic* perspective. This is a crucial distinction as unknown paternity presents the major problem of accidental forbidden marriage to one's relative [2].

In conclusion, the topic of post-mortem sperm retrieval is extremely complex. Though this essay does not provide an answer to the question, the exploration of its details is fascinating. From all standpoints, implicit or explicit consent from the deceased is essential. In addition, the issue of gaining benefit from the deceased must be considered. Finally, it must be understood that it is unclear whether a man can use this method to fulfill an obligation to procreate or whether he has any *halachic* paternal rights to the child born. These questions are matters of larger continuing *halachic* debates and Rabbis must be consulted.

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REFERENCES

[1] Dostal, J., Utrata, R., Loyka, S., Brezinova, J., Svobodova, M. and Shenfield, F., 2005, Post-mortem sperm retrieval in new European Union countries: Case report, Hum. Reprod. 20:2359-2361.

[2] Grazi, R. and Wolowelsky, J.B., 2001, Parenthood from the grave. The Jewish Spectator 65:4

[3] Halpern, M., 2001, Post mortem sperm retrieval. Jew. Med. Ethics 4:9-13.

ANESTHESIA: MODERN INNOVATION WITH BIBLICAL ORIGINATION

Sharon Gordon

The history of anesthesia in the scientific world dates back to ancient times when primitive means of diminishing pain were employed during operations. In the 16th century, Paracelsus, a known chemist and physician, described a method of distilling ether [1]. Since then, potent forms of anesthesia have been developed for clinical application. The 19th century served as a milestone for the development of anesthetics as dentists demonstrated the unique effects of nitrous oxide and ether when administered during dental surgery [1]. However, despite these modern landmarks, the first uses of anesthesia predate these events by centuries, originating in the time of the Bible.

Anesthesia causes a reduction or loss of sensitivity to pain either locally or generally. It is used during minimally invasive procedures, as well as in more involved surgeries. Today, anesthesia is administered to thousands of patients daily during medical procedures throughout the world. The purpose is to eliminate the pain felt by the patient while rendering the patient either unconscious or unaware of the procedure. There are four main types of anesthetics: general anesthesia, spinal anesthesia, regional and local anesthesia, and conscious sedation. General anesthesia is composed of three elements: narcosis, relaxation, and analgesia [2]. Sleep is induced, followed by muscle relaxation, and then the administration of an analgesic to eliminate pain. General anesthesia depresses the central nervous system (CNS) by either inhibiting the excitability of presynaptic neurons, or enhancing the inhibitory postsynaptic neurons, or possibly both. The molecular mechanisms of general anesthetics are a source of much debate [3]. Numerous theories have been proposed to account for the varied effects of general anesthesia. The most common are the Lipid Theory and the Protein Theory. The former maintains that the potency of an anesthetic correlates to its lipid-solubility. It is proposed that an anesthetic works by dissolving in hydrophobic areas of the CNS and altering the physiochemical properties of the phospholipid bilayer. These changes may affect the ability of the neuron to undergo excitation in order to transmit an action potential. The Protein Theory suggests that an anesthetic interacts with proteins within the cell membrane, and not solely with lipids [1].

AS EXPLAINED BY RABBI DAVID KIMCHI (RADAK), A RENOWNED BIBLICAL COMMENTATOR, *TARDEMAH* REFERS TO A DEEP SLEEP THAT WOULD MASK THE PAIN DURING THE REMOVAL OF ADAM'S FLESH.

Anesthetics are administered in a variety of ways, depending on the desired effect. Most commonly, general anesthesia is given via inhalation or intravenous injection. Spinal anesthesia involves the injection of a local anesthetic into the canal surrounding the spinal cord through a long thin needle. This provides a regional loss of feeling. Regional anesthesia is introduced subcutaneously into an area of a regional nerve while local anesthesia is injected subcutaneously to the area specific to the procedure. This eliminates pain in the area that is undergoing surgery but does not affect the consciousness of the patient. Finally, with conscious sedation, the patient remains awake but experiences a mild tranquility and amnesia, eliminating any memory of the procedure but not the pain entirely [4]. Therefore, it is imperative that a type of local anesthetic is administered in addition to the conscious sedation to reduce the pain associated with the procedure. Conscious sedation may be preferred for certain procedures, as it eliminates common unpleasant side effects, such as nausea, vomiting, and dizziness, which are associated with general anesthesia.

The earliest mention of anesthesia appears in the book of Genesis (2:21) when G-d fashioned Eve from a rib abstracted from Adam's body. The phrase states, "and G-d

caused a deep sleep (Hebrew: *tardemah*) to fall upon the man and he slept." As explained by Rabbi David Kimchi (Radak), a renowned Biblical commentator, *tardemah* refers to a deep sleep that would mask the pain during the removal of Adam's flesh.

There are several Talmudic references to forms of anesthesia as well. There is an account of the use of alcohol as an anesthetic in tractate *Sanhedrin* 43a. The text describes the procedure concerning a man convicted of a crime and sentenced to execution, "When one is led out to execution, he is given a goblet of wine containing a grain of frankincense in order to numb his senses." The presumption is that the alcohol would calm the convicted man as he is led to his death and possibly lessen his experience of pain. A second mention of anesthesia in the Talmud is in *Bava Metzia* 83b, with an anecdote about Rabbi Eleazar, the son of Rabbi Simeon, who underwent abdominal surgery; "he was given a sleeping draught (Aramaic: *sama deshinta*), taken into a marble chamber, and had his abdomen opened." The form of this anesthetic is not further elucidated by the text or by its commentators, but it is assumed to be a sleep-inducing anesthetic to alleviate pain. A final example may be found in *Ketuboth* 77b, which describes a case of cranial surgery. Preparations for the operation are delineated in the text with mention of a possible form of anesthetic, "300 cups must be poured upon his head until his cranium softens." Weinberg [5] summarizes the preparatory steps listed by the Talmud. Provisions begin with the creation of a potion, followed by the choice of an operating room, the application of the potion, and finally, the conductance of the procedure. While a reading of the text may suggest that this mixture was a surgical agent, an alternate interpretation, proposed by the well-known commentator, Rashi (*Ketuboth* 77b), is that it was in fact two steps; the pouring of 300 cups and then the location of the soft spot on the skull to prepare for its opening [6]. With this reading, the potion is used as an anesthetic prior to surgery.

Although there is mention of anesthesia in both the Bible and Talmud, possible *halachic* issues may exist. For instance, with anesthesia come risks, some of which could be fatal. There is a concept in Judaism that emphasizes the importance of guarding one's life. We are given the commandment, "*ushmartem meod et nafshoteychem* (take good heed unto yourselves)." While the biblical context does not refer to one's physical wellbeing, the phrase has been used to demonstrate that one should protect one's physical self (Maharsha's commentary on tractate *Brachot* 32b). If this is the case, would one be permitted to make a conscious decision to undergo general anesthesia if potential risks of the treatment exist? It is commonly understood, however, that today's practice is to permit the use of anesthesia without limitation.

In modern religious practice, there is an instance which demonstrates the use of this medical agent: *brit milah* (circumcision). It was previously thought by physicians that a child would not experience pain during a circumcision performed on the eighth day of his life. However, this opinion has evolved due to scientific data and it is now common practice to utilize local anesthetics prior to the performance of a *brit milah* in an effort to minimize the pain felt by the baby [7]. At times, the *mohel* performing the *brit milah* may provide the baby with a cloth dipped in drops of wine to suck on. This practice, like that of the Talmudists, may relax the baby during the procedure.

The use of anesthetics in modern medical practice is widespread yet its roots originate in biblical and Talmudic literature. Although anesthesia presents risks which could result in significant damage or even death, it is a necessary means for achieving success during operations and in recovery. The use of anesthesia in the Talmud would have included more frequent and severe hazards since scientific knowledge, at that time, was minimal. Nonetheless, the welfare of the patient was always of utmost importance to medical practitioners, as it is today.

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REFERENCES

[1] Ankowiak, B. (2001). How do general anaesthetics works? Naturwissenschaften. 88:201-213.
[2] Gray, T., and Rees, G. (1952) The role of apnoea in anaesthesia for major surgery. Br. Med. J. 892:4790-4791.
[3] Franks, N., and Lieb, W. (1994). Molecular and cellular mechanisms of general anaesthesia. Nature 367:607-613.
[4] Shane, S. (1998). Confessions of a Retired Anesthesiologist. Lowry and Volz, Baltimore, MD.
[5] Weinberg, A. (2006). A case of cranial surgery in the Talmud. J. Hist. Neurosci. 15:102-110.
[6] Rosner, F. (1978). Biblical and Talmudic Medicine. Sanhedrin Press, New York, NY.
[7] Friedman, M. (2009). Anesthesia for a *bris*? The Jewish Press (Brooklyn, NY) 10 Apr.

POMEGRANATES: A HOLY AND WHOLESOME FRUIT

Channa Gila Ovits Levy

Pomegranates (*Punica granatum*) have garnered much of public attention as current research has found their consumption to have multiple health benefits. Little known to most people, the pomegranate received much attention long before the current trend, being extremely prominent in *Tanakh, Mishneh* and Talmud as a symbol of health and fertility, along with having a decorative function. With its religious significance and medicinal benefits, the pomegranate definitely bears a closer look.

Pomegranates play a significant role not just for Jews, but also for many other religions and cultures. They are mentioned in many stories of ancient Greek mythology. For example, in the myth of Persephone, pomegranates are involved in the Greek explanation for the seasons of the year. The myth is that Persephone is tricked by Hades, the god of the underworld, into eating three pomegranate seeds, which subsequently condemn her to reside, for the three winter months each year, in the underworld. During those months in the underworld, the world was barren as her mother, Demeter, the goddess of agriculture, mourned for the temporary loss of Persephone [1].

Pomegranates also often appear in Christian religious decorations; broken pomegranate fruit is considered a symbol of the suffering of their deity. In Islam, the Koran states that pomegranates grow in the gardens of paradise, whereas in Hinduism they are associated with the earth goddess and lord Ganesha, the god of beginnings, as well as being a symbol of fertility and prosperity [2].

With the widespread importance of pomegranates, it is no surprise that they are connected to one of the first stories of *Tanakh*. The story of Adam and Eve's eviction from *Gan Eden* focused on the *eitz hadat tov v'rah*, a tree whose fruit was forbidden to them, as its consumption imparted the ability to distinguish between good and evil. The identity of the particular species of tree is not stated in the text. Some Jewish scholars believe that the tree was the pomegranate tree [2]. It is intriguing, in light of the recently discovered medicinal properties of pomegranates, that Eve saw the fruit as "good for eating and a delight to the eyes" (Genesis 3:6)

The pomegranate continues to appear in *Tanakh*, often being used to characterize the land of Israel as a fertile land of abundance. In Deuteronomy 8:8, when describing the good land to which G-d was bringing the Jews, the pomegranate is included in a special category of produce known as the *shevah minim*, or seven species. These seven agricultural species are the defining plants of *Eretz Yisrael* and show the wealth of the country. In Numbers 13:23, the spies sent to scout out Israel bring back pomegranates, along with grapes and figs, to confirm G-d's words that the land was rich and fruitful. While in the desert, the Jews complained that there were no pomegranates, exemplifying the barrenness of the desert (Numbers 20:5). Later in *Tanakh*, the pomegranate is also symbolic of a more unfortunate event, when in Joel 1:12, the ruin of pomegranates is used to represent the devastation that accompanied the destruction of the second temple: "The vine has dried up, the fig tree withers, pomegranate, palm and apple - the trees of the field are withered and joy had dried up among men."

IT IS SAID THAT THE CROWN WORN BY SOLOMON WAS DESIGNED BASED ON THE "CROWN" OF A POMEGRANATE.

The pomegranate was used as an ornament. The hem of the *meil*, or robe of the *kohen gadol* (the high priest of the temple), was edged in pomegranates made of twisted blue, purple, and crimson yarns (Exodus 39:25). Furthermore, two-hundred pomegranates of bronze adorned meshwork of the capitals atop two pillars in the first temple built by King Solomon (Kings II 25:17). It is said that the crown worn by Solomon was designed based on the "crown" of a pome-

granate [2].

Song of Songs, in describing the allegorical relationship between two lovers, contains many references to the pomegranate, making it a romantic fruit. In 4:3, the narrator describes his beloved saying, "Your brow behind your veil gleams like a pomegranate split open." Later in that chapter (4:13), her limbs are described as an orchard of pomegranates. These verses establish the pomegranate as a fruit which represents beauty. Additionally, the *Midrash* on Song of Songs compares the rows of seeds in the pomegranate to school children learning Torah and sitting in rows.

This preoccupation with regards to pomegranates continues into *Torah She'baal Peh*. The *Mishneh* in *Kelim* (17:1) institutes the pomegranate as a unit of measurement. In the Talmud (*Chagiga* 15b), pomegranate consumption is used as a metaphor to describe a student who chooses only the good: "He found a pomegranate, ate the fruit, and threw away the peel." The pomegranate is again used for a symbolic purpose in *Berachot* (57a), referencing the Song of Songs, in which dreams of pomegranates are interpreted in various ways, depending on the size and state of the pomegranate: "If one sees pomegranates in a dream - if they are little ones, his business will be fruitful like a pomegranate; if big ones, his business will increase like a pomegranate. If they are split open, if he is a scholar, he may hope to learn more Torah... if he is unlearned, he may hope to perform good deeds, as it says: Thy temples are like a pomegranate split open (Song of Songs 4:3). What is meant by 'Thy temples'? Even the illiterate among thee are full of good deeds like a pomegranate." The Talmud also uses the beauty of the pomegranate to envision the beauty of Rabbi Yochanan: "Let him bring a silver cup from the smelter, fill it with the kernels of a red pomegranate, surround it with a crown of red roses, and put it between the sun and the shade, he will then sense in its brilliance the beauty of Yochanan" (*Baba Metziyah* 84a). Lastly, the pomegranate is mentioned in the Talmud as a fruit with many uses: as a dye (*Shevi'it* 7:3) and a test for invisible ink (*Gittin* 19b).

Pomegranates were pictured on Hasmonean coins of ancient Judea as a holy symbol and their image is currently featured on the modern Israeli *lirah* coin. Today, many Torah scrolls are stored with two decorative silver pomegranates covering the tops of their handles [3].

After seeing the prevalence of pomegranate in Jewish texts as a symbol of health, fertility and beauty, it is interesting to note current research on the health benefits of pomegranates. The pomegranate has significant amounts of antioxidant polyphenols, mostly tannins called punicalagins [4]. Pomegranate juice was measured to have an ORAC (antioxidant capability) of 2,860 units per 100 grams [5]. Antioxidants protect the body by neutralizing reactive oxygen species (ROS), or free radicals, which have devastating effects on a person's health, as they have many detrimental effects, from wrinkles to cancer.

With regard to cancer, many studies have shown that pomegranates, or compounds derived from pomegranates, have preventative and ameliorative effects. For prostate cancer, punicalagins from pomegranates, along with urolithins, which are metabolites of the ellagic acid found in pomegranates, were found to effectively inhibit the activity and expression of CYP1B1, a key enzyme target in prostate cancer chemoprevention [6]. In another study, pomegranate juice extract induced apoptosis and inhibited cell proliferation in prostate cancer cells by regulating the insulin-growth factor (IGF) system. IGF plays a crucial role in cancer, as their increased levels lead to an increased cancer risk [7].

Pomegranate may reduce the risk of breast cancer as well. Estrogen, a female hormone that can stimulate the growth of breast cancer cells, is generated by aromatase, an enzyme which converts androgen into estrogen. More than 400,000 women die from breast cancer globally every year. About 75 percent of breast cancers are estrogen-receptor positive, meaning they are stimulated by estrogen [8]. In a study conducted by the Beckman Research Institute, pomegranate extract inhibited aromatase enzyme, implicating pomegranate's potential in preventing estrogen-responsive breast cancers [9]. Pomegranate extract is also suggested to have a role in lowering the metastatic potential of aggressive breast cancers [10].

Oxidative stress is also relieved by pomegranate juice or extract. Hyperoxaluria is a condition where too much of a metabolic byproduct, oxalate, is noted in urine, causing oxidative stress to the kidneys and inducing stone formation. In rats with hyperoxaluria, pomegranate juice helped to reduce crystal formation and prevent damage to the cells of the renal tubule [11]. Type 2 diabetes also causes oxidative stress by hyperglycemia. This is an important contributing factor to the cardiovascular complications of diabetes. In a study of diabetes by the Yeditepe University Medical Faculty, a group of diabetics given pomegranate extract (along with other polyphenol containing compounds) showed a statistically significant lowering of LDL levels and raising of HDL levels, as compared to the control group [12].

Further studies of the effects of pomegranate on diabetes showed that the PPAR gamma, the receptor targeted by antidiabetic drugs, was activated by punicic acid, a compound

found in pomegranates. Apparently, pomegranates may be able to act in similar ways as antidiabetic medications by improving the ability to normalize glucose and to suppress inflammation [13].

Pomegranate peel may also serve as an antimicrobial agent. Analysis of the peels showed phenols and flavonoids, both active microbial inhibitors. When tested in agar gels and in food, the peels proved to be potent inhibitors of bacteria like *Escherichia coli*, *Staphylococcus aureus*, and other food-borne pathogens [14]. Pomegranate rind extract along with copper ions exhibited moderate antimicrobial effects again methicillin-resistant *S. aureus* [15].

The list of health benefits for pomegranate continues with a study that showed that eight ounces of pomegranate juice daily for three months improved the amount of oxygen getting to the heart muscle in patients with coronary heart disease. Pomegranate extract may also help arthritis. When human cartilage cells were treated with pomegranate extract, inflammation was reduced and the enzymes that break down cartilage became less active [16].

In my own research at Yeshiva University's Stern College for Women, with Dr. Harvey Babich, Dr. Alyssa Schuck, and Leah Solodokin, we explored the prooxidant effects of pomegranate extract *in vitro*, both on normal human gingival fibroblasts and human oral cancer cells. Pomegranate extract proved cytotoxic to the cancer cells at lower concentrations than to the normal cells, implicating the possible future role of pomegranate derived compounds in cancer prevention and treatment.

With its religious and medical importance, the pomegranate is a fruit that can be studied from every angle. As described in *Tanakh, Mishneh* and Talmud, the pomegranate is a symbol of health, fertility, and beauty. Furthermore, as noted in current biomedical research, it has many health benefits, including acting as an anti-inflammatory, an antioxidant, an antimicrobial, and a potentially anticarcinogenic agent.

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REFERENCES

[1] About.com. http://ancienthistory.about.com/cs/grecoromanmyth1/a/mythslegends_2.htm (retrieved January 17, 2010). Myths and Legends – Yearly Agricultural Cycle. Myth of the Abduction of Persephone. Bingley.

[2] Religion News Service. http://www.beliefnet.com/News/2005/11/A-Pomegranate-For-All-Religions.aspx?p=2 (retrieved January 17, 2010). A Pomegranate for All Religions. Nancy Haught.

[3] Jewish Virtual Library. http://www.jewishvirtuallibrary.org/jsource/judaica/ejud_0002_0016_0_15954.html (retrieved January 17, 2010). Pomegranate. Y. Feliks.

[4] Nutrition Data. http://www.nutritiondata.com/facts/fruits-and-fruit-juices/2038/2 (retrieved January 10, 2010). Nutrition data for raw pomegranates.

[5] United States Department of Agriculture- Agricultural Research Services. http://www.ars.usda.gov/research/publications/Publications.htm?seq_no_115=224949 (retrieved January 10, 2010). Nutritive Value of Pomegranate Fruit and Juice. R. Thomas and S. Gebhardt.

[6] Kasimsetty, S.G., Bialonska, D., Reddy, M.K., Thornton, C., Willett, K.L., and Ferreira, D. (2009). Effects of pomegranate chemical constituents/intestinal microbial metabolites on CYP1B1 in 22Rv1 prostate cancer cells. J. Agric. Food Chem. 57:10636-10644.

[7] Koyama, S., Cobb, L.J., Mehta, H.H., Seeram, N.P., Heber, D., Pantuck, A.J., and Cohen, P. (2009). Pomegranate extract induces apoptosis in human prostate cancer cells by modulation of the IGF-IGFBP axis. Growth Horm IGF Res (Epub ahead of print).

[8] NY Daily News. http://www.nydailynews.com/lifestyle/health/2010/01/06/2010-01 January 6, 2010 (retrieved January 12, 2010). Pomegranate compounds may ease breast cancer risk.

[9] Adams, L.S., Zhang ,Y., Seeram, N.P., Heber, D., and Chen, S. (2010). Pomegranate ellagitannin-derived compounds exhibit antiproliferative and antiaromatase activity in breast cancer cells *in vitro*. Cancer Prev. Res. 3:108-113.

[10] Khan, G.N., Gorin, M.A., Rosenthal, D., Pan, Q., Bao, L.W., Wu, Z.F., Newman, R.A., Pawlus, A.D., Yang, P., Lansky, E.P., and Merajver, S.D. (2009). Pomegranate fruit extract impairs invasion and motility in human breast cancer. Integr Cancer Ther.. 8:242-253.

[11] Ilbey, Y.O., Ozbek, E., Simsek, A., Cekmen, M., Somay, A., and Tasci, A.I. (2009) Effects of pomegranate juice on hyperoxaluria-induced oxidative stress in the rat kidneys. Ren. Fail. 31:522-531.

[12] Fenercioglu, A.K., Saler, T., Genc, E., Sabuncu, H., and Altuntas, Y. (2009). The effects of polyphenol containing antioxidants on oxidative stress and lipid peroxidation in type 2 diabetes mellitus without complications. J. Endocrinol. Invest. [Epub ahead of print]

[13] Hontecillas, R., O'Shea, M., Einerhand, A., Diguardo, M., and Bassaganya-Riera, J. (2009). Activation of PPAR gamma and alpha by punicic acid ameliorates glucose tolerance and suppresses obesity-related inflammation. J. Am. Coll. Nutr. 28:184-195.

[14] Al-Zoreky, N.S. (2009). Antimicrobial activity of pomegranate (*Punica granatum L.*) fruit peels. Int. J. Food Microbiol. 134:244-248.

[15] Gould, S.W, Fielder, M.D., Kelly, A.F., and Naughton, D.P. (2009). Anti-microbial activities of pomegranate rind extracts: enhancement by cupric sulphate against clinical isolates of *S. aureus*, MRSA and PVL positive CA-MSSA. BMC Complement Altern Med. 9:23.

[16] Health Central. http://www.healthcentral.com/peoplespharmacy/408/61202_2.html November 7, 2005 (retrieved January 17, 2010). Pomegranates Have Many Health Benefits. J. Graedon and T. Graedon.

CLINICAL AND HALACHIC CONSIDERATIONS INVOLVING THE USE OF PORCINE WHIPWORMS TO TREAT INFLAMMATORY BOWEL DISEASE

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At least instinctively, it would be hard to imagine a greater *halachic* challenge than ingesting the ova (eggs) of a parasitic whipworm harvested from the feces of a pig. For that matter, it would seem at least as far-fetched to imagine that the intake of worm eggs could provide genuine therapeutic benefit. However, as recent clinical studies have demonstrated, swallowing large quantities of certain worm eggs induces an immunological reaction that is both beneficial and safe for persons suffering from inflammatory bowel disease ("IBD"). Moreover, when one examines the pertinent *halachic* considerations, there would seem to be ample reason why observant Jews *would* have to recourse to this potentially important new treatment that may alter the natural course of these diseases.

Overview: The use of helminths to treat IBD

Recent studies have shown that helminths (parasitic worms that live inside a host) interfere with the human immune system response at several levels and can protect against outbreaks of various auto-immune indications. In particular, published clinical data demonstrates that administering to patients the ova of a porcine (pig) whipworm will induce down-modulation of the auto-immune response that causes IBD, including Crohn's disease ("CD") and ulcerative colitis ("UC"). This whipworm helminth, *Trichuris suis*, the ova which are referred to herein as "TSO," is non-pathogenic in nature, non-reproductive in humans, and can be produced in pharmaceutical quality and quantities through a process acceptable to drug regulators. Ingestion of these helminths is believed to boost production of regulatory T-lymphocytes, thereby inducing a state of increased tolerance to self-antigens and reducing, if not eliminating, the symptoms of these diseases.

IBD: Symptoms and Pathogenesis

CD and UC are chronic inflammatory disorders that affect the intestines. Crohn's disease is a chronic relapsing inflammatory reaction that can affect any segment of the gastrointestinal tract. Abdominal pain and diarrhea are the core symptoms, and extra-intestinal manifestations of the disease are common. UC is an inflammatory bowel disease that differs from CD in that it mainly affects the colon, and is accompanied by ulcers characteristic of the disease. The nature and extent of inflammation (shallow, mucosal) differs from that seen in CD, in which inflammation is usually found deep in the tissue. The main symptom of Crohn's disease is diarrhea mixed with blood [1].

The exact pathogenesis of IBD is unknown. However, it is thought to result from an excessive immune response to contents of the intestinal lumen (such as bacterial antigens). Genetic factors appear to play some role, but their relevance in UC in particular is limited. Rather, as described below, environmental factors, including the patient's level of hygiene and exposure to helminths seem to play a more important role than genetic factors in the pathogenesis of IBD [2].

THE DEFINITION OF EATING ACCORDING TO *HALACHA* IS DISCUSSED IN THE TALMUD (CHULLIN 103B). ONE VIEW FOCUSES ON THE ENJOYMENT OF FORBIDDEN FOODS "BY THE INTESTINES," WHILE THE OTHER VIEW REGARDS THE PROHIBITION AS FORBIDDING "ENJOYMENT BY THE PALATE."

Current Treatments for IBD

Current treatment for IBD initially involves antibiotics, anti-inflammatory agents and/or corticosteroids. Eventually, most patients will not respond to these treatments, and will be prescribed oral immunosuppressive drugs [1, 3]. More recently, biological immunosuppressives - including the

TNF-α antagonists infliximab (marketed as Remicade®) and adalimumab (marketed as Humira®) have been approved to treat adult and pediatric patients with moderate-to-severe CD, and adult patients with moderate-to severe UC [1, 3].

The remission induction rates from these treatment modalities are sub-optimal. Indeed, despite recent treatment advances, most patients suffer a low quality of life and often require surgery, especially when they develop complications such as fistula, abscesses, or bowel obstruction. In addition, oral and biological immunosuppressive agents have adverse safety profiles when used continuously, including heightened risk of severe infections (including tuberculosis) and lymphomas, as well as congestive heart failure and a lupus-like syndrome. Finally, while current therapies may treat symptoms of IBD, there is no clinical evidence that they positively influence the natural course of the disease. Consequently, even the newer biological agents are not recommended as first-line therapy, and physicians cite the need for more efficacious therapy to avoid these complications [3].

The "Hygiene Hypothesis"

Helminths are a species of parasitic worms. People acquire helminths naturally through contact with contaminated food, water, or soil. The colonization of helminths within humans is most common in children living in tropical areas with poor sanitation. Helminths and humans co-evolved over time. Until the advances of medicine in the twentieth century, humans routinely carried helminths and the human immune system adapted for them. Interestingly, prior to the twentieth century, autoimmune diseases such as IBD were largely nonexistent, and they remain nonexistent today in third world countries where hygienic conditions are less advanced. This inverse correlation between exposure to helminths and autoimmune diseases is often referred to as the "Hygiene Hypothesis." The "Hygiene Hypothesis" posits that the loss of exposure to these organisms has adversely impacted our immune systems, provoking an outbreak of excessive immune responses that cause auto-immune disease, including IBD. More than a mere hypothesis, robust epidemiological data shows that exposure to helminths protects entire populations from auto-immune diseases, including multiple sclerosis, asthma, other allergic diseases and excessive inflammation [4, 5].

The intake of TSO as a proxy for exposure to helminths

For a helminth species to serve as a natural immune modulator (and thus treat IBD in humans), it must be suited for medicinal application. *T. suis* is uniquely suited to play that role for several reasons. First, although *T. suis* is not a human parasite (but rather a porcine parasite), its ova can colonize a human host for several weeks before being eliminated from the body without any specific therapy. Second, *T. suis* cannot replicate in humans. Third, eggs that are shed in the stool cannot colonize another human host because they are not yet embryonated. Also, because TSO require a 3 to 6 week incubation in moist soil to mature, inadvertent spread to others is highly unlikely. Finally, *T. suis* can be isolated and purified free of other agents and organisms [6].

TSO are produced through the colonization of young pathogen-free pigs with *T. suis* from a master ova bank. Ova are then harvested from the feces of these pigs, incubated to maturity and heavily processed to remove any pathogens. Ova then are extensively tested to assure uniformity. They are then used to repopulate the master ova bank and are processed further into a final formulation of the "drug product," which is a clear tasteless and odorless liquid [6].

TSO ova are essentially microscopic in nature, measuring about 24 μm x 54 μm. Once ingested by humans, the ovum hatches to release a single *T. suis* larva. In about two months, the larva matures, migrating from the small bowel to the cecum and ascending colon. The body of a mature adult whipworm is about 1 cm in length. It has a thin hair-like appendage that attaches to the host, giving it a "whip-like" appearance. Like most helminths, *T. suis* cannot mature outside of a host [6].

TSO's assumed mechanism of action

TSO therapy seeks to leverage the strong influence that helminths exert on the human immune system. The key immune response associated with helminth infection is increased production of regulatory T-lymphocytes ("T-reg" cells) [7-9]. T-reg cells are immune cells that suppress inappropriate activation of the immune system, thereby dampening or preventing autoimmune responses. By boosting T-reg cell production, helminth therapy causes improved control of IBD symptoms. In addition to up-regulating T-reg cell production, persons infected with helminths also tend to shift away from a Th1 immune response (cellular immunity) to a Th2 immune response (humoral immunity) [6, 9]. This shift from Th1 dominance towards Th2 appears to decelerate immunological disorders, like IBD, aggravated by a Th1 imbalance.

***Halachic* considerations regarding the intake of TSO**

The Torah makes clear that "of all that creeps in the water and of all the living creatures that creep in the waters . . . you shall not eat of their flesh" (Leviticus 11:10-11). While there is little question that the ingestion of a mature whipworm would run afoul of this proscription, swallowing TSO to treat IBD would appear to present a very different

halachic situation, including for reasons of (i) the size of TSO, (ii) the primitive stage of development of the eventual worm, (iii) the manner of TSO ingestion, and (iv) the severity of IBD as a disease state. Each of these is discussed in sequence, below.

(As a preliminary matter, the fact that TSO are harvested from pigs (and pigs feces, at that) should not, in itself, pose a *halachic* concern. While *T. suis* are colonized inside of pigs, the TSO are distinct from and do not acquire the status of their pig hosts. Moreover, the extensive purification process of the TSO required by regulatory authorities, described above, all but ensures the absence in the drug solution of even a trace of pig cells).

(i) TSO would appear to be too small to have *halachic* relevance

Focusing on the TSO itself, it would appear that their microscopic size should remove them from *halachic* concern. As various authors have noted, including in articles published in the aftermath of the "discovery" several years ago of copepods in New York City drinking water, organisms that are visible only through magnification are arguably not proscribed by the Torah. For example, there are extensive *halachic* summaries set forth by Rabbi J. David Bleich [10], Dr. Harvey Babich [11] and Dr. Yosef Levi [12], each of which, in turn cites numerous classic and contemporary sources opining that organisms not visible to the human eye do not carry significance in the eyes of *halacha*. These include (a) Rav Yechiel Mechel Epstein, who writes in *Aruch HaShulchan* (*Yoreh Deah* 84:36) that, even if magnification confirms the presence of tiny organisms in water, "the Torah did not forbid that which the eye cannot perceive, for the Torah was not given to angels. For, if not so, many scientists have written that the entire atmosphere is also full of extremely minuscule creatures, and that when a person opens his mouth he swallows a number of them. . . . Even if this is so, since the eye cannot perceive them, it is of no significance"; (b) Rav Shlomo Kluger, in *Teshuvos Tuv Ta'am vs-Da'as* (*Mahadura Tinyana, Kuntres Acharon, Siman* 53), who explains that vision achieved solely through magnification is not vision according to *halacha* and is thus not a necessary form of examination; (c) Rav Ovadiah Yosef, in *Yechaveh Da'as* (vol. 4, responsum 47) (citing, among others, the *Meorei Or, Chelek Kan Tahor, Chulin* 58b, and 88a, that "those very small *remosim* [crawling objects] that are not seen in vinegar and flour other than through a microscope, are not something regarding which the rabbis are concerned at all, and it is only regarding those that are visible to the eye are we concerned about the prohibition of *tolaim* [worms]"); and (d) Rav Moshe Feinstein in *Igros Moshe*, who concludes that the *halachic* definition of death is not affected by information learned only through radiographic means just as vinegar is permitted even though microscopic magnification would reveal the presence of insects, because "[t]hese are not the *sheratzim* which the Torah forbade. Using magnification is not mentioned in the *Gemora*. Our forefathers did not use a microscope and it is clear that they kept all the *mitzvos* and did not fail anywhere, even by way of *oness*." (*Yoreh Deah*, vol. II, responsum 146).

According to the *Aruch HaShulchan* (*Yoreh Deah* 84:36), "that which the eye can see, even [if only] against the sun and even if it is the tiniest of the tiny, is a veritable insect." Based on this, it would appear extremely unlikely that TSO is visible at all to the human eye. In the view of *Answers.com*, a 20 μm particle would not be visible to the human eye, which is unable to see anything smaller than a human hair, whose width ranges from 40 to 120 microns [13]. "Therefore, if we were going to create a definition of visible artifacts based on the smallest possible size viewable by the human eye, I would have to conclude that it is about as wide as a hair (40-120 microns) and as long as the head of a pin or about 1,500 microns." [14] Based on that, insofar as the narrower dimension of TSO is barely more than 20 microns (and the wider dimension only 50 microns), it is virtually inconceivable that TSO would be visible to the human eye and should thus be *halachically* permissible.

(ii) Does TSO run afoul of the Torah's admonition against "creeping objects?

Even to the extent that TSO might be deemed visible to highly sensitive vision - and all signs suggest that it is *not* - there is an argument that TSO still may not fall within the prohibition against creeping objects. Rav Ovadia Yosef, writing in the *Yechaveh Da'as*, cites the *Mareh Cohen* on *Zevachim* 72a, who explicates the *Shulchan Aruch's* teaching that a *"beriah"* (a living creature), due to its complete and distinctive form, is forbidden from the beginning of its creation. According to the *Mareh Cohen*, that statement does not mean that a *beriah* is forbidden from the time it is created in the "womb", but rather from the time that it emerges in the *"avir haolam"*, i.e, the atmosphere of the world. Evidence of that conclusion is rooted in the discussion in *Chulin* 89b that *"Gid Hanasheh"* (consumption of the sciatic nerve) is not prohibited while the animal is still in utero. TSO, which are merely ova from which larvae have yet to emerge, may well be *halachically* permissible for the reason that it too does not constitute a *beriah*.

Further, it would appear that a characteristic feature central to "creeping objects" is just that - an ability to move upon the earth, which would not be the case with respect to ova. The *Aruch Hashulchan's* explication of the prohibition against microorganisms is amplified by Rav Shmuel Wosner (in *Teshuvos Shevet Halevi*, vol. VII, responsum 122). Rabbi Wosner addresses the issue of insects that appear visible to the naked eye but which, upon examination, can be seen only as specks or black dots not recognizable as insects. Since they cannot be recognized as insects absent perceivable limbs, antennae or discernible body parts, Rav Wosner regards them as permissible. See also the reported view of Rav Shlomo Zalman Auerbach that an organism that cannot be perceived as living or mobile is not regarded as a "creeping thing that creeps upon the earth" (Leviticus 11:41) [15]. This line of reasoning too may protect the permissibility of TSO insofar as ova plainly are not mobile or recognizable as insects. But see *Chazon Ish* (*Yoreh Deah* 14:6), "[even] if the eye does not recognize it because of its small size, if it is yet whole it does not become nullified by virtue of rabbinic decree because of the law of *beriah*."

(iii) Ingestion of TSO may not constitute *halachic "achilah"*

The definition of eating according to *halacha* is discussed in the Talmud (*Chullin* 103b). One view focuses on the enjoyment of forbidden foods "by the intestines," while the other view regards the prohibition as forbidding "enjoyment by the palate." Since *Rambam, Hilchos Maacholos Asuros*, 14:3, ties the prohibition against forbidden foods to enjoyment by the palate; it would appear that there is no biblical prohibition with regard to any foodstuff not swallowed by mouth. For that reason, if food is placed directly into the stomach or intestines, no prohibition is involved (according to the *Teshuvos* of the *K'Sav Sofer, Orach Chayim* responsum 96), and there is no prohibition against non-kosher ingredients in medications taken by injections, suppositories and the like (according to the *Seridei Aish*, vol. 2, responsum 59) [16]. Accordingly, there may be an argument that the ingestion of unhatched larvae within ova equates to a delivery mechanism through which the "enjoyment" of the "creeping thing" may occur in the intestines, but not in the palate.

(iv) The IBD patient arguably constitutes a *"choleh sheyash bo sakana"*

For a seriously ill patient, all prohibitions in the Torah are set aside except for idolatry, murder and forbidden sexual relations. Accordingly, when a patient is seriously ill, if permitted items are not available, he may be given less forbidden foods and ultimately prohibited items as well. See *Pesachim* 24b to 25a; *Rambam, Mishneh Torah, Yesodei Hatorah*, 5:6-8; *Tur, Shulchan Aruch, Yoreh Deah* 155:3 [17]. A patient with moderate to severe IBD would likely fall into this category.

Although IBD does not typically lead to death, there is a modest incidence of death resulting from bleeding and infection in severe cases (as well as from adverse events, including cancer, brought on by immune systems compromised from current IBD treatments) [1]. According to *Teshuvos Shevet Halevi* (vol. 2 responsum 32), a patient who has a peptic ulcer is considered to be seriously ill. Therefore, even where there is no danger if he does not drink milk, he is allowed to do so one hour after having eaten meat. Insofar as IBD, especially if it is not properly treated, can accelerate death, the ingestion of TSO may be permissible as well based on the patient's serious state of disease.

To be clear, intake by a seriously ill patient of forbidden matter is permissible only to the extent that a permitted remedy is not available or is not effective (*Ramoh, Yoreh Deah* 155:3; *Kitzur Shulchan Aruch* 192:5). Moreover, one may not seek to heal a patient with a forbidden remedy unless the remedy has been reasonably tested or is otherwise deemed effective (*Teshuvos Chasam Sofer, Yoreh Deah* 339 (even if it is not fully proven, a dangerously ill patient may be fed a medicine of doubtful efficacy if it has been tested and the physician claims that it is beneficial). In this case, the efficacy of TSO in published clinical trials, coupled with its pristine safety history - especially by comparison with the adverse safety profile of immunosuppressive agents - would seem to justify on a *halachic* basis the intake of TSO by IBD patients.

Researchers have performed at least four clinical trials with TSO to treat IBD (the "Existing Studies") - two open-label studies in patients with CD and one open-label study and one randomized controlled trial in patients with UC [6, 18]. In these Existing Studies, TSO was shown to be a safe and effective treatment for CD and UC, including in patients also using steroids and or anti-inflammatories.

Specifically, researchers first conducted two pilot studies, enrolling 4 refractory (i.e., patients who had relapsed on currently approved therapies) CD and 3 refractory UC patients who had failed high dose steroid and immunosupressives, treating them with a single dose of 2,500 ova and observing them for 12 to 15 weeks. Three of the 4 CD patients achieved a clinical remission within 8 weeks of the single dose (as measured by a standard index of clinical symptoms used for determining how CD responds to treatments) [6, 19]. After 8 weeks, the effect waned and two of the patients

relapsed. (This time frame was assumed to correlate with the fairly rapid loss of *T. suis* from its human hosts). Of these four patients, the one who had not responded was treated with 2,500 ova every 3 weeks and then achieved a durable response lasting over 3 months. One of the patients who had a remission from a single dose and relapsed at 12 weeks was treated with 2,500 ova every 3 weeks, and achieved a remission lasting over one year.

Based on that pilot data, an open-label single-arm study was conducted in 29 refractory CD patients who were treated with 2,500 ova every 3 weeks for 24 weeks [18, 19]. Therapy with TSO was associated with substantial and sustained improvement. At 12 weeks, 66% of patients had achieved remission and 76% had responded; at 24 weeks, 73% had achieved remission and 80% had a meaningful response. These results are better than those observed with anti-TNF antibodies and affected more durable and stable remissions [20].

Results achieved in the UC pilot study were similar: three patients with refractory UC were treated with a single oral dose of 2,500 TSO and observed every two weeks for 12 weeks [6]. All 3 patients achieved remission with a single dose by week 8, and 2 were treated in maintenance with 2,500 ova every 3 weeks, remaining in remission for more than a year [6, 19]. A randomized, double-blind, placebo-controlled study with a crossover period then was conducted in 54 active UC patients [19]. Patients ingested placebo or 2,500 TSO in suspension on a bi-weekly basis. After the first 12 weeks of treatment, placebo-treated patients were switched to TSO for a second 12-week interval and TSO patients were switched to placebo [20]. The blind nature of the study was maintained during the crossover phase.

Of the 54 patients enrolled in the study, 24 received placebo and 30 received TSO during the first 12 weeks of the study. A significantly higher number of patients treated with TSO (43.3%) responded than with the placebo (16.7%). In addition, there were significant differences in most of the signs and symptoms of the disease, including that TSO-treated patients had statistically significant improvements in stool frequency, blood in the stool, mucosal appearance, and overall assessment compared with baseline values.

No drug-related adverse events were reported in any of the Existing Studies, which spanned the oral administration of TSO to approximately 82 patients with IBD (33 patients with CD, 49 patients with UC), including at least three IBD patients who received tri-weekly TSO for at least one year [6, 18, 19]. No ova or parasites were detected in the stools of patients who received TSO, despite exams at baseline and every six weeks [18, 21]. Given the statistically significant efficacy reflected in the Existing Studies and its flawless safety profile, the ingestion of TSO by IBD patients would appear to be permissible as a proven remedy for a *choleh sheyaish bo sakana.*

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REFERENCES

[1] Crohn's and Colitis Foundation of America. http://www.ccfa.org/ and various attachments thereto.

[2] Weinstock, J.V., Summers, R.W., Elliott, D.E. (2004). Helminths and harmony. Gut 53: 7-9.

[3] Datamonitor Stakeholder Insight: Inflammatory Bowel Disease Survey 2007 Q3.1

[4] Stein, R. (2008). Immune Systems Increasingly on Attack. Washington Post, March 4, 2008, p. A01 (available at http://www.washingtonpost.com/wp-dyn/content/article/2008/03/03).

[5] Correale, J. and Farez, M. (2007). Association Between Parasite Infection and Immune Responses in Multiple Sclerosis. Ann. Neurol. 61:97–108.

[6] Summers, R.W., Elliott, D.E., Qadir, K., *et al.*(2003) *Trichius suis* seems to be safe and possibly effective in the treatment of inflammatory bowel disease. Amer. J. Gastroenterol., 98:2034-2041.

[7] Doetze, A., Satoguina, J., Bruchard, G., *et al.* (2000). Antigen-specific cellular hyporesponsiveness in a chronic human helminth infection is mediated by T(h)3/T(r)1-type cytokines IL-10 and transforming growth factor-beta but not by a T(h)1 to T(h)2 shift. Intern. Immunol. 12:623.

[8] Van den Biggelaar, A.H.,lopuchaa, C., van Ree, R., et al. (2001). The prevalence of parasite infestation and house dust mite sensitization in Gabonese schoolchildren. Intern. Arch. Allergy Immunol. 126:231-238.

[9] Bentwich, Z., Weisman, Z., Moroz, C., et al. (1996). Immune dysregulation in Ethiopian immigrants in Israel: relevance to helminth infections? Clin. Exper. Immunol. 103:239.

[10] Bleich, J.D. (2004). New York City water. Tradition 38:70-111.

[11] Babich, H. (2009). Biblical and Talmudic microbes. Derech HaTeva, a Journal of Torah and Science. 13:64-68.

[12] Levi, Y. (2005). *Shmini – kashrut* of microorganisms. Jerusalem College of Technology, Machon Lev, http://www.jct.

[13]Answers.com.http://wiki.answers.com/Q/Is_a_twenty_micron_particle_visible_with_naked eye&alreadyAsked=1&rtitle=Is_this_question_What_is_the_smallest_particle_size_that_can_be_seen_with_the_naked_human_eye (retrieved December 30, 2009).

[14] Fenton, H. (2009). Graphic Arts Online.
http://www.graphicartsonline.com/blog/Print_Trends/20918-How_Small_is_the_Smallest_Objectionable_Spot_.phphttp://www.graphicartsonline.com/blog/Print_Trends/20918-How_Small_is_the_Smallest_Objectionable_Spot_.php (retrieved January 8, 2010).

[15] Neuwirth, J., *Shemiras Shabbas ke-Hilchasah*, vol. I, 2nd ed. (Jerusalem 5739) 3:37, note 105.

[16] Bleich, J,D. (1985). Intravenous feeding on Yom Kippur. J. Halacha Contemp. Soc., 10: 85-98.

[17] Steinberg, A. (2003). Dietary Laws. *Encyclopedia of Jewish Medical Ethics*, 297-306. Feldheim, Jerusalem, Israel.

[18] Summers, R.W., Elliot, D.E., Urban, J.F. Jr., et al. (2005). *Trichruis suis* therapy in Crohn's disease. Gut 54(1):87-90.

[19] Summers, R.W., Elliott, D.E., Weinstock, J.V. (2005). Is there a role for helminths in the therapy of inflammatory bowel disease? Nation. Clin. Pract. Gastroenterol. Hepatol. 2:62.

[20] Elliott, D.E., Summers, R.W., Weinstock, J.V. (2005). Helminths and the modulation of mucosal inflammation. Curr. Opin. Gastroenterol. 21:51-58.

[21] Summers, R.W., Elliott, D.E., Urban, J.F., Thompson, R.A., Weinstock, J.V. (2005). *Trichuris suis* therapy for active ulcerative colitis: a randomized controlled trial. Gastroenterology 128:825-832.

THE "WARRIOR" GENE EXEMPLIFIED IN ESAU

Leora Perlow

Kabbala teaches that the reason for Abraham to sire both Isaac and Ishmael and for Isaac to sire both Esau and Jacob was to filter the negative traits from the nation of Israel. The positive traits were harnessed within Isaac and Jacob, while directing the negative traits within Ishmael and Esau. A particularly villainous character was Esau, who exhibited aggressive behavior, as well as uncontrolled anger, and risk-taking, as displayed by his molesting women and committing murder.

With recent advances in science, researchers' knowledge about the human genome is increasing rapidly. These advances have spurred a new trend within western society: the tendency to blame an individual's actions on his biological, biochemical, and genetic makeup, rather than hold him responsible for his own behavior. Recent studies have proven that the defective gene for the enzyme, monoamine oxidase A (MAO-A), when combined with a high level of testosterone, triggers aggressive behavior; this defective gene is dubbed the "warrior" gene. The impaired MAO-A gene leads an individual to have much difficulty controlling emotions and stress, resulting in a high propensity toward aggressive behavior, risk-taking, fighting, rape, and murder. An examination of Esau's life and his warrior-like actions reveals the possibility that he had an MAO-A deficiency. If so, this raises an even more difficult question as to whether Esau should be held responsible for his crimes.

When functioning properly, the MAO-A gene is responsible for breaking down neurotransmitters in synapses of the brain. A study performed in 2006 on New Zealand's Maori, an aggressive population known for fighting, gambling, and addictions, showed that many of them carried a gene known to induce a similar aggressiveness in animals. Researchers theorized that this gene noted in laboratory animals is what led to the particular behavior within the Maori population. At the National Institute of Mental Health, in Bethesda, Maryland, studies were performed comparing the responses of normal individuals and individuals with the "warrior" gene who were shown frightening, emotion-inducing images, such as terrified faces. Only individuals with the "warrior" gene expressed hyperactivity in their amygdalae, the area of the brain which responds to fear. The researchers hypothesized that those expressing this defective gene were unable to control their emotions, causing them to behave rashly more often. Additionally, a study performed both in Bethesda and Sweden showed that high levels of testosterone coupled with low MAO-A activity leads to anti-social behavior [1].

ALTHOUGH PEOPLE ARE NOT RESPONSIBLE FOR THE LOCATION OF THEIR *NEKUDAT HABECHIRA*, THEY ARE ACCOUNTABLE FOR TRYING TO OVERCOME THE CHALLENGES.

In 1993, a human, six-generational pedigree was compiled of a European family, which included many males displaying violent or aggressive behavior. The last two generations included seven males exemplifying this behavior. Five of these seven were tested for the MAO-A mutation and all five were found to express this deficiency. Eleven males in these two generations were not known for this type of behavior and of them, four were tested; all four had the normally functioning MAO-A gene. Such data provided strong scientific evidence of the behavioral effects of the "warrior" gene [2].

There is no doubt that Esau had a propensity toward fighting. Even while he was still a fetus, Esau argued with Jacob over who should exit the womb to be the firstborn. In the end, Esau won because he threatened, "If you do not let me go out first, I will kill my mother and leave through the stomach wall." Jacob then replied, "This wicked one is a murderer from his inception," and allowed Esau to exit

first (*Midrash HaGadol, Bereishit* 25:22) [3]. According to *Midrash Tanchuma* (*Ki Tetzei* 4), when Esau did leave Rebecca's womb, he caused such damage that she was not able to bear the twelve tribes. In addition, **Shocher Tov** (120:7) noted that Esau hated peace [3]. Such an inclination toward fighting is characteristic of MAO-A deficiency

Esau was also notorious for risk-taking, best displayed in the selling of his birthright. As noted in the *Midrash Shir Hashirim* (18), "Just as *Hashem*'s name rested on Jacob, so too it rested on Esau. Esau was worthy of producing kings and Jacob of priests. All of these gifts were taken away, however, when Esau sold his birthright to Jacob." In the text of the Torah, Esau asked aloud, "What use to me is a birthright?" Just as the Maori are prone to gambling, Esau was always found taking risks. Explains *Tanna d'Bei Eliyahu Zuta* (19), when Esau sold the birthright to Jacob, the two brothers agreed that Esau would take his portion in this world and Jacob would take his portion in the World to Come [3].

Because G-d did not want Abraham to witness the wickedness of his grandson's degenerative actions, such as rape and murder, He shortened Abraham's life by five years. The Talmud, tractate *Bava Batra* 16b explains that on the day of Abraham's funeral, Esau raped an engaged woman, committed murder, traded his birthright, and denied resurrection of the dead along with God's existence. Esau was known to have raped several women in his lifetime and there is Talmudic discussion about how many *mamzerim* came from him. In addition, Esau murdered Nimrod, to take his garments for himself (*Breishit Rabba* 65:16). Esau also intended to kill Jacob after his father, Isaac, died in order to inherit his brother's lot (*Shocher Tov* 2:4) [3]. Such aggressiveness and uncontrolled anger are symptomatic of a mutated MAO-A gene.

Finally, Esau's "warrior" gene is possibly best expressed when he encountered Jacob on the battlefield. Esau arrived on the scene with four hundred men, each an army general (*Breishit Rabba* 75:12). He still harbored his anger against Jacob from decades earlier and was willing to risk his life to battle against his brother. His full intentions were to murder Jacob [3]. Esau's readiness for war displayed another characteristic of the "warrior" gene within him.

Yet, if Esau expressed an MAO-A deficiency, a burning question arises: should he be held accountable for his actions? After all, he was only playing the cards he was dealt, expressing the traits that G-d Himself had given him. According to Rabbi Akiva Tatz [4], the Westernized mindset would answer that due to Esau's genetic, biochemical mutation, he should not be punished for his actions. Esau was subject to the inherent forces which pulled him to the direction of wickedness. Thus, one cannot blame Esau for his deeds.

However, the Jewish approach disagrees. Rabbi Tatz explains that according to Rav Eliyahu Dessler, each individual has a *nekudat habechira*, a point of free will. It is in this area that one is challenged and must make decisions. Although people are not responsible for the location of their *nekudat habechira*, they are accountable for trying to overcome the challenges. G-d is not asking, "Why is your point of free will at that particular level?" Rather, He asks, "How did you cope with the tests you were given? Did you raise your *nekudat habechira* as you struggled to overcome difficulties?" [4]. Rav Natan Slifkin, in an essay on *Parshat Vayeshev*, states, "It is in *Hashem's* hands alone to determine what we have. But it is in our hands alone to determine what we are" [5].

According to Talmud, tractate *Sotah* 13a [3], Esau died in protest of Jacob's burial in the Cave of Machpela when Chushim, the deaf son of Dan, struck him with a club, thereby decapitating him. Esau's head rolled into the cave and landed at Jacob's feet. That is where it remained. Rav Aharon Kotler wrote that Esau, who learned Torah from our forefathers Abraham and Isaac, merited having his head be buried in the Cave of Machpela. Yet, since he never took this Torah to heart, since he did not use this Torah to guide his actions, only his head could be buried in the Cave [6]. Judaism holds Esau responsible for his short-temper, risk-taking, rape, murder, and overall wickedness throughout his lifetime. Indeed, he was given a difficult lot, possibly possessing the mutated "warrior" gene, but he did not live up to his potential. He did not strive to overcome this challenge. Rather, he let it dictate his actions and his life.

May we all have the strength to overcome the challenge of our *nekudat habechira*, despite whatever genetic lots we have been given. With God's help, this will hasten the coming of *Mashiach, Bimheira b'yameinu*, Amen.

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REFERENCES

[1] Holden, C. (2008). Parsing the genetics of behavior. Science: 322: 894-895.

[2] Cummings, M.R. (2009). Single genes control aggressive behavior and brain metabolism, Human Heredity: Principles & Issues, 8th edition. Brooks/Cole Cengage Learning, Chicago, IL.

[3] Chasidah, Y. (2000). Esau, Encyclopedia of Biblical Personalities: Anthologized from the Talmud, Midrash, and Rabbinic Writings, 5th impression. Mesorah Publications, Ltd. Brooklyn, NY

[4] Simple To Remember. Rabbi Akiva Tatz: The Thinking Jew's Guide to Life: Free Will - the Real You, http://www.simpletoremember.com/media/a/free-will-the-real-you1/ (Retrieved January 4, 2010).

[5] Slifkin, N. (1997). Focus: Classical and Contemporary Issues through the Lens of the Weekly Parasha. Targum/Feldheim, Southfield, MI

[6] The Chumash. December 1998. Mesorah Publications, Ltd. Brooklyn, NY

THE METABOLIC EFFECTS OF ALIYAH

Rivkah Rogawski

The Jewish community, although insular, has historically been affected by global trends. One such phenomenon sweeping across the world is the increasing prevalence of metabolic syndrome. The term "metabolic syndrome" is used to describe a symptom cluster including elevated triglycerides, an elevated waist circumference, elevated fasting glucose levels, reduced HDL cholesterol levels, and elevated blood pressure [1]. The arrival of metabolic syndrome in a specific population usually follows the arrival of technology and industry and the subsequent abandonment of culturally-based eating patterns [2]. The integration of the Ethiopian and Yemenite communities into Westernized Israeli culture offers a case study of this trend.

When the first wave of Yemenites and Ethiopians arrived in Israel, they exhibited almost no diabetes [3]. Throughout 25 years in Israel, diabetes rates in the Yemenite community rose by 12.5%, and after five years in Israel the Ethiopian community began to exhibit diabetes at a rate of 5-8%. Researchers who sampled the Ethiopian community for risk factors found signs of metabolic syndrome amongst the Ethiopians, including abdominal fat accumulation and elevated insulin levels [4]. It was also found that mortality rates for coronary artery disease increased amongst Yemenite immigrants during their second decade in Israel [5]. Clearly, a change of environment has triggered metabolic changes that lead to a host of deleterious effects. A proper understanding of this trend is important to the young Israeli community.

This effect has also been observed in other communities that were transitioned from a primitive lifestyle to a Western lifestyle. One factor that researchers have implicated is the abandonment of an ethnic diet in favor of a Western diet [2]. In a fascinating study conducted amongst the Aborigines of Australia, researchers were able to greatly improve and even reverse the effects of metabolic syndrome by returning ten Aborigines to their native habitat and diet. The study subjects, who were suffering from metabolic syndrome, were placed in a traditional setting where they hunted for foods such as turtle, crocodile, birds, kangaroo, and yams. Although these foods are not "low-fat" or "low-carb", a return to this diet was sufficient to reverse damages wreaked by a highly-processed Western diet.

CLEARLY, A CHANGE OF ENVIRONMENT HAS TRIGGERED METABOLIC CHANGES THAT LEAD TO A HOST OF DELETERIOUS EFFECTS.

Researchers are also beginning to believe that the genetics of individual communities has evolved to be suited to a particular diet [6]. Therefore, their metabolic phenotype may be unsuited to a Western diet and lifestyle. One compelling factor in favor of this conclusion is the fact that, depending on how their environment has molded their genetics, populations responds differently to the Western lifestyle. For example, the Pima of South America have thrifty phenotypes well adapted to the frequent famine of Mexico. The Evneki of Siberia, on the other hand, have very fast metabolisms that allow them to rapidly convert fat to energy in order to survive the Arctic winters. Although both populations become obese and prone to heart disease when placed in Western environment, each manifested unique metabolic changes. While the Pima developed high rates of diabetes and cholesterol, but retained low blood pressure, the Evenki retained low levels of cholesterol and diabetes but developed high blood pressure. Genetics clearly has a role in how populations respond to Western lifestyles. In Israel, the Ethiopians, like the Pima, exhibited a thrifty metabolic genotype, and similar to the Pima, began to exhibit risk factors for diabetes after 18 months in Israel [4].

Another factor that may contribute to first-generation immigrants developing metabolic syndrome is a metabolic version of maternal imprinting, in which the mother's di-

etary environment affects her unborn fetus and nursing infant [7]. This metabolic imprinting primes the child for a specific environment by establishing set points for the child's metabolism. Researchers suspect that molecular pathways such as those involving glucose and leptin, molecules which are transmitted from the mother to the fetus, may play a role in the establishment of the infant's set points. Therefore, if the child is placed in an environment different from the one that its parent inhabited, and then its maternally inherited "set point" will be maladapted to the new diet and lifestyle. For example, mothers who experienced famine or undernutrition tend to produce low-birth weight infants with thrifty metabolisms, a phenotype that responds poorly to the Western diet [6]. By this logic, malnourished Ethiopian or Yemenite mothers will produce children primed for a similarly malnourished existence, children who may develop diabetes and heart disease when placed in the Westernized Israeli environment.

The American nutrition community is beginning to recognize that nutritional advice should be customized to different ethnic groups. A recent study that followed the effects of DASH, or Dietary Approaches to Stop Hypertension, found the guidelines to be effective amongst certain communities but not amongst others [8]. This led to the realization that DASH should be customized to suit the nutritional needs of each ethnic group. Perhaps the Israeli community, with its patchwork quilt of Sephardic and Ashkenazi ethnic groups, will similarly recognize the need to customize nutritional advice and lifestyle to its many inhabitants.

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REFERENCES

[1] O'Riordan, M. (2009). New joint statement streamlines definition of metabolic syndrome, www.medscape.com.

[2] Pollan, M. (2007). In Defense of Food, Puffin Books, NY, 2007.

[3] Weingarten, M.A., Katzir, I., Sprecher, E., Kobzantsev, S., Zelzer, C., and Kahan, E., (2000) Diabetes and ischemic heart disease among Yemenite immigrants in Israel, Isr. Med. Assoc. J., 2:207-210.

[4] Aaron, M. and Cohen, L.M. (1989). The health risks of immigration; The Yemenite and Ethiopian cases in Israel, Biomed. Pharmacother., 51:352-359.

[5] Sharabi, Y., Grossman, E., Ironi, A., Levite, R., and Rosenthal, T., (1996). Survey of cardiovascular risk factors in newly arrived Yemenites to Israel, J. Hum. Hypertens., 3:29-30.

[6] Gibbons, A. (2010). What's for dinner? Researchers seek our ancestors answers, Science, 326:1478-1479.

[7] Sullivan, E.L. and Grove, K.L. (2010). Metabolic imprinting in obesity, Forum Nutr., 63:184-196.

[8] Nainggolan, L. (2009). Dietary advice should be tailored to ethnic groups, medscape.com.

OVERNIGHT HAIR WHITENING: A MEDICAL PERSPECTIVE ON THE TALMUD

Kate Rosenblatt

"And the six hours of deadly terror which I then endured have broken me up body and soul. You suppose I am an old man, but I am not. It took less than a single day to change these hairs from a jetty black to white..." [1] This poetic exaggeration refers to the age old myth that sudden terror can cause one's hair to turn white overnight. Although it is typical to encounter such folkloristic and improbable accounts in literary tales, this precise myth was first recorded in the Babylonian Talmud as a story accepted as fact by many people.

In 83 C.E. the primary Talmudic academy in Israel necessitated the selection of a new Rabbinic notable. The esteemed position was offered to the young, but highly competent scholar by the name of Elazar ben Azariah, aged 17 years [2]. In an outburst of deep concern regarding the youthful appearance of her husband, the wife of Rabbi Elazar ben Azariah cried, "You have no white hair" [3]. The day that Rabban Gamliel was unseated was the same day that Rabbi Elazar ben Azaraiah reached his 18th birthday, and on that day 18 rows of his hair inexplicably turned white, an ample amount to mature the appearance of the young scholar [2, 3].

The Rambam, a highly regarded medieval rabbinic figure and physician, offered a medical explanation for this overnight hair whitening phenomenon. For both day and night Rabbi Elazar ben Azariah was enthralled by the texts of Torah and scrupulously engaged in its study. Due to the continuous exertion of his bodily strength in his vigorous daily activity, he appeared a man of 70, even though, chronologically he was much younger [3].

Current medical literature suggests that hair whitening is a natural consequence of the aging process, yet can be aggravated in a sudden manner by certain medical syndromes. Under normal circumstances, as the years pass, the bulb from which a hair grows slowly decreases production of melanin, the pigment that gives hair its color. This diminishing production of melanin causes hair to become lighter in color and eventually to appear gray or white [4].

On the other hand premature graying is coupled with a host of different factors including poor nutrition, thyroid problems, anemia, certain medications, AIDS, and some cancer treatments. In addition, premature graying can sometimes be a reflection of inherited genes [4]. Vitiligo, which tends to run in families, is a condition in which white patches develop on the skin and can affect any location on the body. It is caused by a loss of pigment in the skin due to the dysfunction of melanocytes, the cells that produce pigment [5]. Linked to this cosmetic defect is early whitening of the hair, observed in patients with the disorder [2].

IN AN OUTBURST OF DEEP CONCERN REGARDING THE YOUTHFUL APPEARANCE OF HER HUSBAND, THE WIFE OF RABBI ELAZAR BEN AZARIAH CRIED, "YOU HAVE NO WHITE HAIR".

Although vitiligo has been recognized for over 2000 years and is referenced in Buddhism, Islam, and perhaps Judaism as the potential cause for the depigmentation referred to as *tzaraat*, the factors that cause the onset of vitiligo have not, as yet, been proven scientifically [5, 6]. However, researchers speculate that vitiligo can be caused by either one of or a combination of three factors. The most popular position is that vitiligo is an autoimmune disease, in which the immune system acts aversely toward the body's own tissues and organs. Other theories propose the role of inherited genes as well as just a single event, such as sunburn or emotional distress [5].

Although the literature on vitiligo explains premature whitening of hair, it does not explain the overnight hair whitening phenomenon. However, a disorder known as alopecia areata may provide a more enlightening explanation, particularly in individuals who have "salt and peppr hair," a mixture

of pigmented and non-pigmented hair [7]. Alopecia areata is a condition in which hair is lost from some or all parts of the body. This condition typically affects the scalp, and since bald spots appear in its early stages, it is sometimes referred to as "spot baldness" [8]. Pigmented hairs are usually lost initially, while the non-pigmented hairs are retained. Thus, strands of hair which seem to have suddenly turned white were, in reality, while all along, and were simply unnoticed among the pigmented hairs. This "illusion" can make it appear as though the affected individual has gone white overnight. As to the cause of the condition, presumably it can be triggered by hereditary factors in conjunction with a sudden shock [7].

Still, despite their plausibility, it is difficult to draw on the aforementioned conditions to adequately explain the overnight hair whitening of an individual's full head of hair or beard. The historical accuracy of popular anecdotes such as the overnight hair whitening of Sir Thomas More's beard the night before his execution should be approached with caution as it is medically impossible for grown pigmented hair to transform into non-pigmented hair [2, 7]. Vitiligo and alopecia areata, which cause hair whitening to occur much more rapidly than natural whitening processes, seem only to account for the rapid and progressive hair whitening that occurs over a prolonged period of time rather than over one night [2]. Thus, the sudden overnight hair whitening of Rabbi Elazar ben Azariah was not likely attributable to any specific medical condition, but rather as traditionally accepted, to a miraculous event.

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REFERENCES

[1] Poe, Edgar A. (1841). A Descent into the Maelstrom. The Essential Tales and Poems of Edgar Allan Poe, Fisher, B. (Ed.). Barnes and Noble Books, New York, NY.

[2] Goldenhersh, M.A. (1992). Rapid whitening of the hair first reported in the Talmud: Possible mechanisms of this intriguing phenomenon. Amer. J. Dermatopathol.. 14:367-368.

[3] Rosner, F. (2000). Encyclopedia of Medicine in the Bible and the Talmud. Jason Aronson Inc., Northvale, NJ.

[4] UAB Health System. Dear Doctor Column. http://www.health.uab.edu/17722/ (retrieved January 12, 2010).

[5] MedicineNet. "Vitiligo." http://www.medicinenet.com/vitiligo/article.htm (retrieved January 12, 2010).

[6] Norlund, J.J., Boissy R.E. (Eds.) (2006). The Pigmentary System, 2nd edition. Blackwell Publishing, Malden, M.A.

[7] Keratin.com. "Sudden White Hair Onset." http://www.keratin.com/as/as017.shtml. (retrieved January 20, 2010).

[8] Wikipedia. "Alopecia Areata." http://www.medicinenet.com/vitiligo/article.htm. (retrieved January 20, 2010).

PHYSICAL AND SPIRITUAL HAIR IN TORAH AND TALMUD: MEANING AND MESSAGE

Rose Snyder

Many characters from the Torah and Talmud are well-known by the descriptions that are given regarding their hair. These descriptions may seem trivial, but they play important roles in the Biblical narratives and, thus, in the development of Jewish history. King David had strikingly red hair. Esau, in addition to also having this unique hair coloring, was born with a layer of hair covering his entire body. Absalom's hair was extraordinarily beautiful because it was both long and curly. Of course, this physical beauty led to his downfall, as he eventually got caught in a tree, hanging by the very hair he had so meticulously groomed. Unlike Absalom, Elijah the Prophet was known for having hair that he did not groom, which gave it a long and wavy appearance and made him subject to the ridicule of others. These physical descriptions are also important because they relate to modern scientific discoveries about the growth and appearance of hair. "Geneticists know very little about hair," but descriptions that are given in the Torah and Talmud relate to what we do currently know [1].

Through these different descriptions, the Torah and Talmud emphasize the physical characteristics of hair. Specifically, in the *Tanach* certain hair textures and lengths are described. In Kings II (1:8) the prophet Elijah is ridiculed by being called a hairy man because his hair was unusually wavy and long [2]. Absalom's hair is also singled out. He would grow his hair so long that he had to cut it every so often to prevent it from getting too heavy (Samuel II 14:26). The *Midrash* explains that his strands of hair were thick and curly; they are compared to carobs and would "grow like a chain" [3]. These aspects of his hair, its length and texture, allowed it to get stuck in the branches of a tree.

While the Torah gives these descriptions, modern science provides an understanding of the physiology and morphology of hair. Each strand of hair can be divided into three sections along its length: the bulb is where the hair originates beneath the skin surface; the root is the remainder of the hair within the skin; and the shaft is the part of the strand above the skin. Hair grows as the cells of the bulb divide and multiply. These new cells push the old cells toward the skin surface, which increases the length of the hair strand. As the cells are pushed away from the bulb and the blood supply, they become keratinized and die. Keratinization is the process in which the cell's moisture is replaced with a tough, insoluble protein called keratin. Hair of the scalp can grow about 1 millimeter in three days and attain a length of about one meter. It will grow for about 2-4 years before entering a resting stage during which no new cells are formed. After about 1-2 years in this stage, the cells divide once again; new hairs begin to grow, which pushes the older hairs from their follicles, causing them to fall out [4].

UNLIKE ABSALOM, ELIJAH THE PROPHET WAS KNOWN FOR HAVING HAIR THAT HE DID NOT GROOM, WHICH GAVE IT A LONG AND WAVY APPEARANCE AND MADE HIM SUBJECT TO THE RIDICULE OF OTHERS.

Each strand of hair can also be divided along its cross section: The medulla is the core made up of cells and air spaces. Surrounding it is the cortex made up of more densely-packed keratinized cells. The outermost layer is the cuticle, which is a single layer of scaly cells that overlap each other. Different hair textures actually result from different cross sectional shapes; straight hair is round, wavy hair is oval, and curly hair is almost flat [5].

In addition to texture and length, the Torah describes another aspect of hair that directly relates to modern scientific discoveries. The *Midrash* in *Shemot Rabbah* 24:4 teaches that one man saw a snake in the desert and "became so terrified that his hair began to fall out, and they called

him baldhead." This physical description actually relates to a hair disorder known as alopecia areata, rapid hair loss in multiple areas of the scalp. Some factors associated with this disorder are genetic predisposition, metabolic disorders, and cell-mediated immune factors. Another important factor is stressful events and emotional stress [6]. This last factor suggests that the sight of the snake triggered emotional stress in the man mentioned in the *Midrash* and led to his development of alopecia areata.

Esau is another character who highlights the physical emphasis that the Torah puts on hair and its connection to science. Upon his birth, Esau is described as a "cloak of hair" (Genesis 25:25). In fact, the *Tur* explains that even inside the womb Esau's hair bothered his twin brother Jacob, and Jacob tried to get away from it. This led to immense physical pain for their mother, Rebecca, and implies that the prenatal struggle between these brothers was entirely natural [7]. Some suggest that Esau suffered from a rare genetic disorder called hypertrichosis, which is also known as "werewolf syndrome" [2]. This sex-linked dominant disorder causes a thick coat of hair to grow over the entire body except the palms and feet. Individuals with this syndrome have more hair follicles and, therefore, have denser and more abundant hair [1]. One specific element that characterizes this disorder is that the individual is often "born with full body hair" [8]. This description certainly suggests the condition possibly suffered by Esau, who is immediately described as being covered in hair.

Esau plays an important role in this discussion for another reason: in the Torah he is also described as an "*admoni*" which is derived from the root word "*adom*," meaning red, and which is used to refer to the color of his hair (Genesis 25:25). Only one other Biblical character, King David, is described as an "*admoni*" (Samuel I 16:12). He was known among the Jewish people for his red hair and beautiful eyes. Hair color is due to a pigment called melanin, produced in the bulb of the hair and then transferred to the cells of the cortex. Dark hair contains melanin, whereas blond hair has it in decreased amounts. Red hair is derived from an iron-containing pigment called trichosiderin [5]. Common hair color in individuals varies for different geographic locations [9]. In fact, in Leviticus 13:31 it is noted that "Semites normally have black hair" [2]. Modern scientific studies have similarly shown that while variation in human eye and hair color is common among people of European ancestry, "most other human populations are fixed for brown eyes and black hair" [9]. This explains why the Torah was explicit in describing Esau's and King David's red hair; it was simply unusual.

However, in addition to this physical description, the Torah also implies that hair color conveys a deeper meaning about the individual's character traits. The *Midrash* in *Breishit Rabbah* 63:8 explains that because Esau and King David are described as "*admoni*," they are both destined to spill blood. In fact, the *Midrash* explains, when Samuel, who was commanded by God to anoint the next king over Israel, saw David's red hair, he was afraid. God allayed his fear by explaining that while Esau became a murderer, David will only kill by the command of the Jewish court of law. Thus, according to that *Midrash*, red hair implies a red life; hair color is used to connote a message that is deeper than any physical attribute. It reveals something about the individual's character and destiny.

Interestingly, hair analysis is sometimes used as a scientific method. It can reveal malnutrition, defects in metabolism, or cause of death. The deficiency of certain elements in the hair or the accumulation of poisons can serve as indicators for these conditions. Hair analysis is often exploited, however, by some who claim that hair can assess an individual's general nutritional status. They maintain that certain deficiencies can be revealed, in order to recommend certain special diets. This pseudoscience has not been proven to be useful [5]. The *Midrash*, however, in using the red hair color to describe both physical appearance and character traits, implies that hair does reveal something deeper about a person. It describes more than an amount of melanin and trichosiderin; it has spiritual meaning, as well.

Like with the term "*admoni*," many other examples from Torah and Talmud show that hair may be referenced for purposes other than describing physical appearances. It takes on a spiritual and figurative meaning as noted in *Sukkah* (51a): Rabbi Yehudah says that in the future God will "slaughter" the Evil Inclination before the righteous and before the wicked. Before the righteous it will appear like a tall mountain, and before the wicked like a strand of hair. The Talmud compares the Evil Inclination to a strand of hair to emphasize that despite its insignificant size, the wicked were unable to overcome it. Here the concept of hair takes on a purely figurative form. It is used as a metaphor rather than a description of a character's physical appearance.

Thus, although hair is used in the Torah to describe physical appearances, it also contains a deeper meaning. The physical descriptions given by the Torah relate well to modern scientific discoveries about hair, but in addition to these physical descriptions are their deeper meanings. The fusion of the physical and spiritual is discussed in much of Torah literature. It is expressed by the *Midrash* when explaining

that although Absalom's beautiful hair signified that his external beauty was complete, his inner beauty was lacking [3]. It is expressed by Tziporah Heller in her book *Our Bodies Our Souls* when citing the *Sha'arei Kedusha*: "Judaism considers everything about the body to be a source of information about a deeper human spiritual truth" [10]. We know little about hair and we know even less about the spiritual meaning behind it, but we do know that, as with most things in life, there are both physical and spiritual elements to it. The trick is finding how they can be fused together.

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REFERENCES

[1] Lewis, R. (1996). Human Genetics: Concepts and Applications, Second Edition, Wm. C. Brown, Dubuque, IA.

[2] Rosner, F. (2000). Encyclopedia of Medicine in the Bible and Talmud. Jason Aronson Inc., Northvale, NJ.

[3] Midrash Yalkut Mean Loez, Samuel II, chapter 14.

[4] Tortora, G. J. and Grabowski, S. R. (1996). Principles of Anatomy and Physiology, Eighth Edition. John Wiley & Sons. NY, NY

[5] Saladin, K. S. (2001). Anatomy and Physiology: The Unity of Form and Function, Second Edition. McGraw Hill, NY, NY

[6] Huethner, S. E. and McCance, K. L. (1996). Understanding Pathophysiology, Third Edition. Mosby, St. Louis, MO.

[7] Nachshoni, Y. (1991). Studies in the Weekly Parashah. Mesorah Publications, ltd, Jerusalem, Israel.

[8] Olshan, J. "Wolf Boy's Hope." New York Post. 20 November 2008.

[9] "Variation in Skin/Hair/Eye Pigmentation." Online Mendelian Inheritance in Man. Johns Hopkins University. 4 November 2009.

[10] Heller, T. (2003). Our Bodies Our Souls. Targum Press, Inc., Southfield, MI.

MANDRAKES: A MYSTICAL PLANT OR LEGITIMATE HERBAL REMEDY? THE CHAMBER OF SECRETS HAS BEEN OPEN!

Loriel J. Solodokin

The mandrake, *Mandragora officinarum*, is a perennial plant found in the Middle East, southern Europe, and northern Africa, that has ovate leaves, white or purple flowers, and edible globose yellow fruits, historically thought to have aphrodisiac properties. The mandrake also has a large bifurcated root, which has been credited with human attributes and has been the subject of many myths and superstitions. The root was formerly used as a cathartic, narcotic, soporific, and a conception promoting supplement. Common names for the fruit of the mandrake include: "love apples," "May apples," and "devil's apple" [1].

One of the earliest references to the conception promoting properties of the mandrake is found in *Bereshit* (30:14), where Reuven, Leah's eldest son, brings her *duda'im* from the field. Rachel, Leah's younger sister, requests that Leah give her some of the *duda'im* that her son brought her because she wanted children. Leah, however, only acquiesces on the condition that Ya'akov will cohabit with her during that night. Ya'akov agrees and Leah, thereafter, bears her fifth son (*Bereshit* 30:17) and later a sixth (*Bereshit* 30:20). It should be noted that according to may opinions, *duda'im* are considered aphrodisiacs; for this reason it is believed that the word is derived either from the Hebrew word *dodim*, meaning love, or from the Arabic word *du*, meaning two, in addition to *daim*, meaning lovers. [2]

The botanical identity of *duda'im* is quite difficult to ascertain. The accepted opinion, however, is that it is a plant that grows, blossoms, or ripens "in the days of the wheat harvest" (*Bereshit* 30:14). Most biblical commentaries translate *duda'im* as mandrakes. *Rashi* writes that the *duda'im* are a type of plant that the Arabs call *yasmin*, which is translated in English as the mandrake. Ibn Ezra asserts that *duda'im* have a good aroma, as it is written in *Shir HaShirim* (7:14), "*duda'im* give forth fragrance." They resemble the human form for they have the likeness of a head and hands. *Ibn Ezra* concludes, however, that he does not know why they promote conception.

Ramban disputes *Rashi's* interpretation of *duda'im*, and instead accepts the opinion of *Onkelos*, who translates them as *yavruchin*. They are called *yavruch* in Arabic and mandrakes in English. *Ramban* explains that Rachel wanted the *duda'im* not to promote conception, but rather to enjoy and take pleasure from their aroma, for it was through prayer that Rachel's barrenness was alleviated, and not via medicinal means. Reuven brought his mother the fruit of the mandrake, which looked like apples and were aromatic. He did not, however, bring the root, which has the likeness of a head and hands, and which is said to facilitate conception. It is interesting to note that *Ramban* concludes that he is unable to find proof to the latter assertion in any medical books available in his time.

REUVEN BROUGHT HIS MOTHER THE FRUIT OF THE MANDRAKE, WHICH LOOKED LIKE APPLES AND WERE AROMATIC.

Rabbi Dr. Joseph H. Hertz, the former Chief Rabbi of the United Kingdom and Commonwealth, quotes the 1611 King James' authorized version of the Bible where the word *duda'im* is translated as "love apples." Hertz explains that the fruit is the size of a large plum, quite round, yellow, and full of soft pulp. The fruit is still considered in the East as a love charm. This would explain Rachel's anxiety to obtain it [1].

The *Ba'al HaTurim* beguilingly points out that the Hebrew word *duda'im* has the same gematria, numerical value, as the word *ke'adam*, like man (i.e. having human likeness). The numerical correspondence fits beautifully with the appearance of the forked root of the mandrake.

The *Malbim* states that *duda'im* promote conception and that Reuven's intent was for his mother to have more sons since he did not wish to be the only son. The *S'forno*, however, interprets *duda'im* to be aromatic plants which pre-

pare the womb for a fetus. *Duda'im* and even more potent aphrodisiacs were eaten, especially on Fridays, to increase the love between two young paramours. Rabbi Shimshon Raphael Hirsch, on the other hand, considers *duda'im* to be wild flowers.

In explaining the biblical passage concerning mandrakes, the Talmud (*Sanhedrin* 99b), asks, "What are *duda'im*?" Rav says *yavruchi-Rashi* translates this as mandrakes; Levi says *sigil*-the *Aruch* identifies this as cypress, the *Musaf HaAruch* as the narcissus plant, and *Rashi*, in *Berachot* 43b, as violets; Rabbi Yonatan says *sabiski-Rashi* explains this as mandrake flowers/a certain kind of spice. The *Midrash*, in *Bereshit Rabbah* 72:2, adds two interpretations of *duda'im*: barley and fruits of *mayishim*, which are hackberries or myrtle berries.

Dr. Julius Preuss, a German physician and scholar who gathered medical and hygienic references in Jewish sacred, historical and legal literatures, explains that the *duda'im* perhaps brought the favor of Yaakov back to Leah; for the one night which Rachel conceded to Leah must have been followed by many more, as the subsequent births demonstrate. The mandrakes, however, did not provide Leah with fertility, for she had never lost her ability to conceive. The correction of the infertility of Rachel as a result of the *duda'im* is similarly difficult to accept for Preuss. Since the pregnancies of both women resulted from the hearkening by G-d to their prayers and, moreover, since according to religious interpretation, no medication is effective without G-d giving His blessing thereto, Leah and Rachel's pregnancies cannot be used as evidence for or against the efficacy of the mandrakes. As a result, Preuss cannot accept the hypothesis that *duda'im* represent a remedy against infertility. He is also not disconcerted by the biblical phrase, "the mandrakes emit an aroma," *Shir HaShirim* 7:14, for it is a long way from the effectiveness of an aroma as a sexual excitant to the presupposed influence on the sterility of a woman [1]. It is interesting to note that Rabbi Jacob Kouli, a 17th century scholar from the Greek island of Crete, writes that many physicians during his time recognized mandrakes as a fertility aid.

Ben Ish Chai, the author of *Rav Pealim*, a collection of *halachik* responsa, records the opinion of contemporary physicians that mandrakes are a wonderful remedy for eye infections and inflammations. This would be another excellent explanation as to why Reuven brought his mother mandrakes (i.e. to heal her eyes), since Leah suffered from eye problems: "Leah's eyes were weak" (*Bereshit* 29:16), because she ruined them with crying [2]. (Since Leah thought that she would have to marry Esav, which was a dreadful notion to her, she cried to the point where her eyes were ruined from her constant tearing.)

Assaf the Physician writes in his Book of Medicines that powdered mandrake root, if applied externally, can heal white spots and leprosy. If it is applied to the white of the eye, the finely mashed up pulp of the fruit can cure pussy discharges from the eye. Lastly, if it is kneaded with oil and honey it can cure snake and scorpion bites. Modern research, in fact, supports the claim that mandrake roots and berries have a sedative, analgesic, effect and are beneficial in cases of poisonous bites from snakes and scorpions [2]. Interestingly, mandrake use as a surgical anesthetic was first described by the Greek physician Dioscordes, around AD 60, in which patients preparing to undergo surgery were fed mandrakes [3].

Today, mandrakes are considered poisonous and their use should be strictly confined to well trained practitioners or professional herbalists. Nonetheless, shepherds and Bedouins continue to consume mandrake berries, which have shown, via chemical analysis, to contain an active narcotic agent. The active component in mandrake root is hyoscine, also referred to as scopolamine, a tropane alkaloid drug which is quite similar to atropine in its mechanism of action. (Atropine is a drug that lowers the parasympathetic activity of all muscles and glands regulated by the parasympathetic nervous system.) Hyoscine, like atropine, blocks the muscarinic effects of acetylcholine, a neurotransmitter in the central and peripheral nervous systems, thus allowing it to be classified as an anticholinergic agent. Unlike atropine, however, hyoscine readily crosses the blood-brain barrier, thereby lending it the ability to produce drowsiness, hallucinations, and anesthetic affects [4-6].

According to Dr. Robert Greenblatt, the calming action caused by the mandrake root might have lessened Rachel's anxiety about not being able to bear children, and thereby might have permitted better hypothalamic-pituitary function [7]. There is a continuous mutual interaction between the hypothalamus-pituitary system and ovarian function. The implication, therefore, of hyoscine found in the mandrake root on the hypothalamus-pituitary system is to relax that system, thereby allowing for elevated levels of gonadatropins, such as follicle stimulating hormone (FSH) and luteinizing hormone (LH), which act synergistically to induce follicular growth, ovulation, and development of the corpus luteum [8-10]. The mandrakes given to Rachel would, therefore, have made it easier for her to conceive a child since her body's hypothalamic-pituitary system was rendered more relaxed due to the presence of neurorelaxers, such as hyoscine.

A fascinating study was done by researchers in the Hadassah Medical School which found that mandrakes contain a minute quantity of sex hormone. Such a finding lends further credence to the mandrake's reputation as being a fertility agent. Experiments with laboratory animals have shown that mandrakes produce sexual arousal, as well [2]. It is interesting to note that other studies, designed to find a connection between mandrakes and sex hormones, have produced contradictory findings to the study at Hadassah Medical School. Those studies found that certain components in mandrakes have a high progesterone binding activity, thereby behaving antagonistically to progesterone (i.e. mandrake components chemically adhere to progesterone binding sites, thereby, not allowing progesterone to produce its intended hormonal effect). (Progesterone is a steroid hormone involved in the menstrual cycle which permits the endometrium to enter its secretory phase and, thereafter, prepare the uterus for implantation.) Mandrakes, therefore, can be used as abortifacents, emmenagogues (i.e. brings on menses), and, oddly, to facilitate child birth. It is dangerous to the vitality of the fetus for mandrakes to be consumed during pregnancy [11, 12].

While there is much controversy over the exact identity of *duda'im*, most biblical commentaries are of the opinion that they are mandrakes, a plant which has been thought to possess aphrodisiac qualities since time immemorial. There seems to be an impasse, however, amongst the commentaries, as to the validity of the mandrake's ability to act as a sexual stimulant and/or to promote conception. Modern scientific studies, however, have elucidated that mandrakes possess anesthetic, hallucinogenic, and narcotic characteristics, in addition to possibly containing anticholinergic agents and sex hormones which can collectively effect the central and peripheral nervous systems, and, moreover, the hypothalamic-pituitary system. Such scientific evidence can, therefore, serve as corroboration not only of the mandrake's ability to alleviate infertility in the time of the Bible, but also its ability to herbalistically treat various modern-day conditions.

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REFERENCES

[1] Rosner, F. (1980). Mandrakes and other aphrodisiacs in the Bible and Talmud. Korot. 7: CCLXXVII-CCLXXXIV.

[2] Shaouli, M.C. and Fisher, Y. (1999). Nature's Wealth: Health and Healing Plants, Steinberg, R. (Ed.). Beit Knesset Shauli, Ashdod, Israel.

[3] Carter, A. (2003). Myths and mandrakes. J. Royal Soc. Med. 96:144-147.

[4] Carter, A. (1999). Dwale: An anaesthetic from Old England. Br. J. Med. 319:1623-1626.

[5] Wikipedia, The Free Encyclopedia. Hyoscine. http://en.wikipedia.org/w/index.php?title=Scopolamine&oldid=339315339 (Retrieved January 25, 2010).

[6] Wikipedia, The Free Encyclopedia. Atropine. http://en.wikipedia.org/w/index.php?title=Atropine&oldid=339713656 (Retrieved January 25, 2010).

[7] Greenblatt, R.B. (1966). Aspects of infertility. Proc. Royal Soc. Med. 59:1282-1284.

[8] The Museum of Menstruation and Women's Health. Some Details on the Function of the Hypothalamus-Pituitary-Ovaries Axis. http://www.mum.org/souhpoax.htm (Retrieved January 25, 2010).

[9] Wikipedia, The Free Encyclopedia. Follicle Stimulating Hormone. http://en.wikipedia.org/w/index.php?title=Follicle_stimulating_hormone&oldid=23568523 (Retrieved January 25, 2010).

[10] Wikipedia, The Free Encyclopedia. Luteinizing Hormone. http://en.wikipedia.org/w/index.php?title=Luteinizing_Hormone&oldid=175523664 (Retrieved January 25, 2010).

[11] Smith, E. Phytoestrogens, Some Good and Some Bad for Exacerbation of Migraine Headache. http://www.migraine101.com/phyto.htm (Retrieved January 25, 2010).

[12] Zava, D.T., Dollbaum, C.M. and Blen, M. (1998). Estrogen and progestin bioactivity of foods, herbs, and spices. Proc. Soc. Exp. Biol. Med. 217:369-378.

CONTINUATION OF SPECIES: CLONING TO SAVE ENDANGERED AND EXTINCT ANIMALS

Malka Weil

The Torah commands us to send away the mother bird before taking her young (Leviticus 22:28). Ramban, a medieval biblical commentator, explains that the reason for this commandment is to ensure the continuation of the species. If mother and child are killed on the same day, there would be no-one left to live and reproduce and thus the entire family would become extinct.

In the world today, our environment has been largely affected by humanity. Humans have been responsible for reducing natural habitats by developing land for industry and depleting the supply of natural resources, processes which have driven many species of animals to become endangered and extinct. Through breeding programs and attempts to protect the dwindling habitat, zoos and other organizations have been working to conserve these animals from disappearing permanently. A new form of biotechnology was created in the past two decades that could be another strategy to save these endangered species, and even possibly bring back the extinct ones; a process called cloning.

Cloning was first proved successful in 1997 when the lamb Dolly was born. She was created using the nucleus from a single epithelial cell of an adult sheep. In this process, an epithelial cell from an adult sheep was electrically fused with an enucleated egg obtained from a similar species of sheep. This egg, now containing a diploid nucleus, behaved as a zygote, undergoing mitotic divisions to develop into a preembryo, which was then implanted into a surrogate mother. This surrogate mother eventually gave birth to a lamb which was a genetic copy of the adult sheep that provided the diploid nucleus [1].

Since Dolly, there has been much research conducted in the field of cloning. A difficulty encountered was that the adult genetic material used to produce the clone was already aged, so the offspring contained "aged" adult genes, which potentially could shorten the life of the clone. Also, even though the nuclear DNA of a clone is identical to the DNA of the nucleus donor, cells also contain DNA in their mitochondria. Mitochondrial DNA is typically passed from the mother to the offspring. In this cloning procedure, the mitochondrial DNA was from the donor of the enucleated egg, rather than from the adult sheep who donated the diploid nucleus. So even though the vast majority of the DNA passed onto the clone was from the nuclear donor, the mitochondrial DNA was from the enucleated egg donor, therefore Dolly was a close but not perfect genetic copy of the original sheep [2].

DOES *HALACHA* (JEWISH LAW) PERMIT CLONING ANIMALS TO SAVE ENDANGERED AND EXTINCT SPECIES?

This method has been further tested and successful clones of mice, sheep, cattle, pigs, goats, and a housecat have been created. In 2001, a clone of a guar, an endangered cattle-like species, was born [3]. A report in 2009 noted the cloning of an extinct subspecies of the wild goat, called a bucardo (*Capra pyrenaica pyrenaica*), which died moments after its birth from lung failure [4]. Although the successes are rare, and much work and finances have gone into these endeavors, with future research and practice, cloning can become a way to save endangered species and bring back extinct ones.

Does *halacha* (Jewish law) permit cloning animals to save endangered and extinct species? From an examination of the commandment *shiluach hakan,* the sending away of the mother bird before taking its young, it would seem that that Torah is most positively in favor of the continuation of the various species and would endorse the use of biotechnology to save endangered and extinct animals. Furthermore, in the *Tiferet Yisrael* (*Yadayim* 4:3) it states that if something is not prohibited explicitly in the Torah, then it is permitted. Nowhere in the Torah is there a mention or hint of cloning, therefore, presumably it would be allowed. Additionally, Ramban explains the passage, "*umilu et haaretz*

vekivshuha," i.e., "to fill the world and conquer it" (Genesis 1:28) as a commandment given to Adam, the first human being, to use the powers of science that God has granted humans to develop the world. Accordingly, cloning is a powerful scientific force for humans to explore and to control with judgment.

On the other hand, there is a concept of "*derech hateva*," i.e., "the natural course." It is the rationale for the prohibition of practicing magic and of mixing different species (*Sefer Hachinuch* law 62 and 244). With His infinite wisdom, God created the world to run its natural course. Therefore, cloning may be prohibited because it interferes with the natural way of the world. The majority of the issues that come up in discussions of cloning by modern day rabbis are questions about the status of the clone. Questions include, who is the father or mother? What status does the baby have in its place in the nation of Israel, which includes issues of honoring parents, tribal status, and deciphering which *mitzvot* (commandments) are obligatory. Other issues include whether the clone would even be considered a living human being, because although it is a living, breathing creature, it was created in a laboratory [2]. All such discussions center around human clones, not cloned animals. Animals are not subject to *mitzvot* and have no obligations to others. Therefore, the only practical *halachic* issue regarding a cloned animal would be if a clone was kosher for eating.

That question, however, does not pose a problem to the issue of cloning endangered species of animals. The purpose of cloning such animals is to allow them to repopulate, not to eat them. The main issues facing the cloning of endangered and extinct species are (a) whether cloning is permissible according to *halacha* and (b) whether the animal would be still considered one of its species (because its mitochondrial DNA is from another species) and therefore valuable to the conservation efforts. There is no clear answer yet, because cloning is still in its experimental stages and the chances of developing a healthy clone are slim. With further experimentation, this question will have to be addressed. From the available sources, it appears that most *halachic* authorities would be in favor of cloning endangered and extinct species. As far as the concept of *derech hateva* goes, it could be argued that extinction is not the natural course of the world either, but was caused by humans hunting and the destruction of natural habitats. Cloning the animals to save them would actually restore the natural "*derech hateva*" that was jeopardized. Although there are no conclusive answers to the question of animal cloning, the sources point to the positive, and as science progresses, the world may once again be able to be home to so many amazing creatures that are endangered or extinct, as God originally intended.

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REFERENCES

[1] Pennisi, E. (1997).The lamb that roared. Science. 278:2038-2039.

[2] Loike, J.D. and Steinberg, A. (1998). Human cloning and halakhic perspectives. Tradition 32.3:31-33

[3] Lanza, R.P. et al. (2000). Cloning of an endanger species (*Bos gaurus*) using interspecies nuclear transfer. Cloning 2:79-90.

[4] Folch, J. (2009). First birth of an animal from an extinct subspecies (*Capra pyrenaica pyrenaica*) by cloning. Theriogenology.71:1026-1034.

PREMARITAL GENETIC SCREENING AND ITS RAMIFICATIONS FOR THE JEWISH COMMUNITY

Aviva (Schiffmiller) Weinberg

For most of history, Jewish people have avoided intermarriage with members of other religious and ethnic groups. This may be attributed to both the conscious observance of the Torah commandment that states, "You shall not intermarry with them; you shall not give your daughter to his son, nor take his daughter for your son" (Deuteronomy 7:3), as well as the social and geographic isolation of Jews from secular society throughout the ages. Such reproductive patterns are no different from any other group of people or animal species that practices inbreeding (mating exclusively within themselves), which often leads to the retention and expression of harmful recessive traits [1]. As such, characteristic genetic diseases such as Tay-Sachs and familial dysautonomia have long plagued the Jewish population, since the deleterious genes remain in the gene pool indefinitely.

The recent advent of premarital genetic testing has made significant inroads into reducing the prevalence of genetic disorders in the Jewish community. Genetic screening operates by obtaining a blood sample to test if an individual possesses recessive genes for a series of genetic diseases. Most genetic diseases result when a child inherits two recessive genes for the condition, with each parent contributing one copy of the defective gene. Thus, it is only problematic for a couple when each partner, termed a carrier, has one copy of the same deleterious recessive gene. If just one parent contributes a copy of the deleterious recessive gene, the child, albeit normal, has a 50% probability of being a carrier of the disease [2].

One of the largest and best-known programs for premarital genetic screening is Dor Yeshorim, which is Hebrew for "generation" (*dor*) of "the righteous" (*yeshorim*), which services Jewish communities in America, Israel, and Europe. It was founded in 1983 by Rabbi Josef Ekstein of Brooklyn, NY, after four of his children died from Tay-Sachs disease, an autosomal recessive genetic disease. The organization visits high schools, as well as boy's *yeshivot* and girls' seminaries in Israel, obtain blood samples, and assign each participant an ID number. Dor Yeshorim tests for a suite of genetic diseases, including Tay-Sachs disease, cystic fibrosis, Gaucher disease type I, Canavan disease, familial dysautonomia, Bloom syndrome, Fanconi anemia, glycogen-storing disease type 1a, mucolipidosis type IV, and Niemann-Pick disease type A. Most of these conditions occur with at an elevated frequency among Jews of Ashkenazi origin.

THEREFORE, IF TESTS ARE AVAILABLE, AS THEY ARE IN PREMARITAL GENETIC SCREENING, IS ONE REQUIRED TO PARTICIPATE?

When the participants are of marriageable age and are either dating someone or have been suggested a *shidduch* (a potential match), each party exchanges ID numbers and contacts the Dor Yeshorim hotline. The ID numbers are reported to the operator, without exposing any personal information and, thereby, remain completely anonymous. The operator retrieves the records for each number and determines whether the individuals are carriers for the same genetic disease. If not, the couple is told that their marriage would be advisable; if carriers for the same disease, they are told that their marriage would be inadvisable. The specific disease for which the couple may be carriers is never disclosed at any time, thereby, maintaining complete confidentiality [3]. Since the inception of the organization, Dor Yeshorim has tested over 200,000 singles and informed 700 couples that their union would be inadvisable [2].

Premarital genetic testing, specifically as performed by Dor Yeshorim, raises a plethora of ethical questions from a secular vantage point. Firstly, by not informing the participants of whether they are carriers of specific genetic diseases, the system seems to take away the individual's right to obtain personal information. Secondly, the program in-

fringes on the ability of people to freely choose their spouse, as Dor Yeshorim may inform them that it is not prudent to marry. Finally, not all the genetic diseases tested for by Dor Yeshorim are conditions that severely compromise the life of a child born with the disorder. While some are almost always fatal (like Tay-Sachs disease), the severity of other genetic disorders may depend on a variety of factors and may be mild and/or treatable. Therefore, it is questionable if a couple should be advised not to marry if they are carriers for a disease that is of a less debilitating nature.

When confronted with these challenges, Dor Yeshorim responds that the genetic screening conducted is a voluntary procedure that communities have adopted of their own free choice. Thus, no rights have been taken away from the participants. In addition, the completely confidential process in which the identity of the specific genetic disease is not specified prevents stigmatization of those who are carriers. Finally, and most importantly, the screening process is the only manner in which Jewish families can avoid the extreme anguish of having children with tragic physiological pathologies. This, after all, was the original goal of the founder, who experienced first-hand what it means for a family to be devastated by a genetic disease [3].

For observant Jews, genetic screening presents not just ethical questions but *halachik* issues as well. According to the *Zohar* (*Genesis* 7:11), in the latter part of the sixth millennium, "the gates of wisdom will open on high and fountains of wisdom will open below" in preparation for the anticipated Messianic era in the seventh millennium. According to the Jewish calendar we currently are living towards the end of the sixth millennium and, as such, it is appropriate from a Torah perspective that long-standing mysteries in science are now being uncovered. The Human Genome Project will map out and identify every gene in the human being and is one example of the increasing wisdom granted to mankind in preparation for the future. Furthermore, according to the Rambam's interpretation of the *mitzvah*, "And you shall love the Lord your G-d" (Deuteronomy 6:5), as explained in *Hilkhot Yesodei HaTorah*, 2:2, the knowledge and the love of G-d is intrinsically linked. The only way for humans to "know" G-d and thus come to love Him, is through a thorough understanding of His creations, again reinforcing the importance of advances in science.

However, while genetic mapping may lie in the realm of gaining understanding in science, having one's own genes screened does not fall under the same category. Therefore, if tests are available, as they are in premarital genetic screening, is one required to participate? One would not be contributing to scientific exploration. But on the other hand, one may be able to avoid transmitting genetic diseases to future offspring. Rav Moshe Feinstein addressed this issue around the time when Tay-Sachs testing was first being implemented (*Iggerot Mosheh, Even ha-Ezer*, IV no. 10). While he acknowledged the argument that one should simply trust in G-d when it comes to such matters, he did not feel that is applicable when it comes to genetic testing. Indeed, he regarded that failure to undergo such a test was equivalent to "closing [one's] eyes [in order not] to see that which it is possible to see." Furthermore, he encouraged precautions to be taken to ensure patient confidentiality and thereby to avoid stigmatization of carriers, since not everyone will understand that being a carrier does not pose a threat to their health. Dor Yeshorim certainly incorporated Rav Feinstein's advice with its completely confidential system [4].

Despite the seeming *halachik* approval of premarital genetic screening, it is important to recognize that post-marital screening is not always permissible. Many leading rabbinical figures, including Rav Malkiel Kotler (a *Rosh Yeshiva* of the Beth Medrash Govoha in Lakewood, NJ) and Rav Shmuel Kamenetsky (Co-*Rosh Yeshiva* of the Talmudical Yeshiva of Philadelphia, PA) expressly forbid genetic and chromosomal tests on pregnant women to determine illnesses and deformities in their fetuses. Such tests are forbidden because Torah law almost never allows for abortions, except under very extreme circumstances [4]. Therefore, Rav Feinstein forbade the use of amniocentesis to diagnose fetal Tay-Sachs disease, since the physician may encourage abortion of such a fetus [5]. However, if the tests serve a constructive purpose, such as for treating the fetus *in utero* or for preserving the mother's health, then such tests are allowed [4].

Examination of both the ethical and *halachik* perspectives on premarital genetic screening supports the endeavors of genetic testing organizations such as Dor Yeshorim. With G-d's help, the continuing advancement of genetic testing and further knowledge of genetic disorders will one day eliminate all such conditions from the Jewish population.

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REFERENCES

[1] Encyclopædia Britannica Online. http://www.search.eb.com/eb/article-9042236/ (retrieved Oct. 5, 2009).

[2] Markowitz, S. (2005). Genetic testing: A blessing or a curse? Jewish Observer 38: 16-21.

[3] Vizner, Y. and A.E. Raz (2008). Carrier matching and collective socialization in community genetics: Dor Yeshorim and the reinforcement of stigma. Soc. Sci. Med. 67: 1361-369.

[4] Bleich, D. (2000). Genetic screening. Tradition 34: 63-87.

[5] Eisenberg, D. The ethics of genetic screening. Aish HaTorah. http://www.aish.com/ci/s/48909807.html/ (retrieved Oct. 6, 2009).

THE ARBA MINIM

H. Babich, Ph.D.

"You shall take for yourselves on the first day the fruit of the *hadar* tree, the branches of date palms, twigs of a plaited tree, and brook willows; and you shall rejoice before HaShem, your G-d, for a seven day period" (Vayikra 23:40). This sentence is the source for the four plant species (i.e., the *arba minim*) used on *Succot*. The *hadar* tree refers to the citron tree (*Citrus medica*), in particular, to its fruit, the *etrog* (citron); the date palm tree (*Phoenix dactylifera*) which is the source of the *lulav*; the plaited tree is the myrtle tree (*Myrtus communis*), which has trifoliate groupings of leaves, forming a braided appearance, and comprises the *hadasim*; and the willow brook tree (*Salix acmophylla*) is the source of the *aravot*. The unit of the *arba minim* consists of one *etrog*, one *lulav*, two *aravot* branches, and three *hadasim* branches (*Succah* 34b).

Although the *arba minim* are stated explicitly in the Torah (Vayikra 23:40), no explanation is provided to specify why these four species of plants were selected. Various symbolisms suggesting the uniqueness of each plant have been presented. For example, these four plant species symbolize key components of the human body, with the central rib of the *lulav* symbolizing the human spinal column, the leaves of the *hadasim* the eyes, the leaves of the *aravot* the mouth, and the *etrog* the heart (Yalkut Shimoni, Emor 6, 2; Vayikra Rabbah 39:14). Another explanation is that the four species symbolize four types of Jews. The *etrog*, with its fragrance and taste, represents Jews who learn Torah and perform good deeds; the *lulav*, having taste (i.e., its dates) but no fragrance, symbolizes those with Torah learning but without good deeds; the *hadasim* lack taste, but have fragrance, representing Jews without Torah learning but with good deeds; and the *aravot* with their lack of taste and fragrance symbolize Jews lacking both good deeds and Torah learning (Menachot 27a; Vayikra Rabbah 30:12).

The lack of a botanical explanation for the selection of these specific four species apparently bothered Rabbi Samson Raphael Hirsch [1], who suggested that these four species were selected as each dwells in a different ecosystem, based on their individual temperature requirements. The *lulav* requires a torrid zone, the *etrog* needs a climate of lesser heat, *hadasim* dwell in a temperate zone, and *aravot* require colder temperatures. Schaffer [2] noted that these four species each inhabit a different ecosystem and each is an advocate for rain, albeit, to different degrees. As noted by Rabbi Eliezer (Ta'anit 2b), "these four species are intended only to make an intercession for water; as these cannot grow without water, so the world cannot exist without water." Schaffer noted that the brook willow, growing near streams and lakes, is a water-loving plant, dwelling in habitats too wet for other the survival of other plant species. At the opposite extreme is the palm tree, found in the desert amidst an oasis. The myrtle inhabits the riverine thickets on the slopes of mountains. The citron, growing in the plains, requires heavy irrigation. One interpretation of the phrase "*hadar* tree" is that it refers to the "hydro tree," or "water tree," as the citron tree requires both natural rainfall and irrigation (Succah 31b). Schaffer's explanation meshes nicely with "water" as the dominant theme for Succot. To quote from the Artscroll edition of the *chumash*, "Many of the observances and prayers of *Succot* are associated with rain – including the water drawing, the prayer for rain, and the four species, which are agricultural products that require plentiful water. The reason for this is that, as the Mishnah (Rosh HaShannah 1:2) states, "on the Succot festival they (i.e., the world) are judged for water" (Bamidbar 29:18).

ALTHOUGH THE *ARBA MINIM* ARE STATED EXPLICITLY IN THE TORAH (VAYIKRA 23:40), NO EXPLANATION IS PROVIDED TO SPECIFY WHY THESE FOUR SPECIES OF PLANTS WERE SELECTED.

The *etrog*, as any fruit, develops from within the flower. The flowers of the citron tree are hermaphroditic, in that, each flower has male structures, termed stamens, and female structures, termed pistils. This arrangement is not true for all flowering plants, as, for the date palm tree, a given plant produces either flowers with stamens (i.e., male trees) or flowers with pistils (i.e., female trees), but never both.

The male structure, the stamen, consists of a long filament on top of which is the anther, in which the pollen grains, or male reproductive units, are produced. Pollen grains from the anther are transferred to the pistil, which is a vase-shaped female structure consisting of the swollen base termed the ovary, which houses the many immature eggs or ovules, and an apical stalk termed the style which terminates in the stigma, the female structure that initially receives the male pollen grains. Once upon the stigma, the pollen grains germinate and pollen tubes burrow through the pistil until reaching the ovules, now containing mature eggs. The pollen grain containing the male haploid genome fertilizes the female haploid genome (the egg), yielding a zygote that will develop into an embryo contained within a seed. After fertilization, cells of the ovary of a flowering plant undergo numerous divisions and become larger, eventually forming the mature fruit. The main bulk of the *etrog* is actually a ripened ovary; the protuberance on the top of the *etrog* is the *pitam*. The *pitam* is comprised of two parts, the stick-like style (referred to as the *dad*) and the rounded top portion (the *shoshanta*), a remnant of the stigma. [Note, sometimes the *shoshanta* and *pitam* together are also called the "*pitam*"]. The reader is directed to the sefer, *Halachos* of the Four Species, by Rabbi D. Oratz [3], in which the issues surrounding an *etrog* whose *pitam* fell off are discussed in detail.

In the Talmud many explanations are put forth regarding the phrase, "*hadar* tree." Rav Yehudah interpreted "*hadar*" as a species of tree whose fruit "dwells" on the tree from one year to the next year (Succah, 31b). Unlike many other fruit-bearing trees, e.g., apple or pear trees, in which ripe fruits detach and fall from the tree, the *etrog* remains on the tree for several seasons and, thus, has the potential to be very large. Rav Yose cited a story, "there was once an incident with Rav Akiva, that he came to the synagogue with his *etrog* carried on his shoulders due to its great size" (Succah 36b). Today, the Yeminite *etrog* tends to be very large.

Depending on its stage in the ripening process, an *etrog* may exhibit various colors. Initially green, the *etrog* turns yellow in the ripening process. "The preferred colors for a kosher *etrog* are the color of wax, i.e., pale yellow, gold, which is a deeper version of wax-colored, and egg-yolk color. Saffron color, which is a greenish yellow color approaching the color of wax, is also kosher. "If an *etrog* is as green as grass, it is not kosher, unless part of it has begun to turn yellow. It should not be used even if it will turn yellow in the near future. It may only be used once the color has begun to turn yellow" [3]. An unripe *etrog* is green, when ripe it is yellow. Fruit ripening is stimulated by ethylene, a plant hormone, which also causes the breakdown of green chlorophyll, revealing the other pigments that signal a ripe fruit. In the case of the *etrog*, the green chlorophyll of the unripe fruit masked the yellow pigments seen in the ripe fruit.

Rabbi Oratz [3] discussed how to "force" a green *etrog* to turn yellow. "A green *etrog* may be forced to turn yellow in the following manner: It should be placed in a box, and surrounded by very fragrant yellow apples. Several apples should be placed over the *etrog*, as well, and the box should be closed for twenty four hours. This is generally sufficient for the *etrog* to begin to turn yellow." The biological explanation for this process is as follows. The fragrant yellow apples are over-ripe and release ethylene, which is a gaseous plant hormone. The apples and the green *etrog* are placed in a closed box, to prevent the ethylene from diffusing into the atmosphere and forcing it to remain in the box and to contact the *etrog*. The ethylene derived from the apples is the stimulant for the ripening process in the *etrog*. Hence the expression, one rotten apple in the bunch, spoils the rest!

The *etrog* tree, being not very hardy and susceptible to parasitic infections particularly of the roots, sometimes is grafted to more hardier citrus trees, e.g., lemon trees. An *etrog* that is the result of grafting (termed a *murkav*) may not be used as a component of the *arba minim* [3]. Although grafting was known in the times of the Mishnah (Kil'ayim 1:7) and the Talmud, there are no discussions concerning grafting of an *etrog* branch to the stem of a different, albeit related, species of citrus tree. Why? In the times of the Mishnah and the Talmud, the *etrog* tree was the only known citrus in *Eretz Yisroel*, with no other species available to serve as the base to which the *etrog* branch could be grafted. Only in the Middle Ages was the lemon tree introduced into the Middle East. Thus, in the times of the Mishnah and the Talmud, the use of an etrog from a grafted tree was not, as yet, an *halachic* issue [4-6]. One reason for the impermissibility of using of a grafted *etrog* for the arba minim is that it is no longer a "pure" *etrog*, as it (the grafted branch, termed the scion) now acquired properties of the plant to which it was grafted (termed the stock) [3]. For example, in a *murkav etrog* derived from a citron branch grafted to a lemon stock, the seeds lie horizontal to the main axis, whereas in a pure

etrog the seeds are longitudinal (or, parallel) to the main axis. Yet, Dr. E. Goldschmidt, of The Hebrew University and a noted authority on *etrogim*, concluded that "genetically, grafting has no effect on the *etrog* fruit, and that the fruit growing on a branch of the *etrog* scion (the stem portion of the tree) will remain the same *etrog* irrespective of the tree used as the stock (the root portion of the grafted tree" [6]. However, recent research confirmed that genetic material is transferred between stock and scion across the graft junctions, allowing genes to cross species barriers [7].

There are four basic phenotypic appearances of the *etrog*: (a) the European (mostly, Italian) *etrog*, which is similar in appearance and size to a lemon, has very little pulp, and is not particularly a tasty fruit; (b) the belt or "*gartle*" *etrog*, with an indentation in the middle and preferred by many chassidim; (c) the tall, slender Moroccan *etrog*, with a perfect *pitam*, yet often seedless; and (d) the huge Yemenite *etrog* that lacks a pulp, but which possesses a thick, white, edible part below the skin (similar, to an apple) [8]. Regardless of these varied phenotypes, genetic analyses of various *etrogim* showed no differences in their DNA profiles as determined by DNA gel electrophoresis [9]. The different phenotypes of *etrogim* are caused by environmental, not genetic, variables. The "*gartle*" *etrog* results from an anomaly in the anthers. The indentation is seen on the young fruitlet only days after opening of the flower. The anthers, arranged in a ring-like structure around the pistil, generally fall off when the fruit expands. In a "*gartle*" *etrog* the falling off of the anthers is delayed, physically constricting the middle of the expanding fruit to form the "*gartle*" appearance. Age of the citron tree affects the phenotype of its *etrogim*. Young, vigorously growing *etrog* trees produce elongated and large fruits, whereas when the same trees ages and weakens, the *etrogim* appear as small, lemon-shaped fruits [6, 10]. Interestingly, seedless Moroccan *etrogim*, when grown in Mexican soil, produce seeds within the fruits (Rabbi Joseph Asia, personal communication).

Another issue that has concerned the purity of the *etrog* is the possibility of hybrid species. This issue centers around the possibility of a bee transferring pollen from the anther of a flower on a lemon tree to the pistil of a flower on an *etrog* tree. Wiseman [11] suggested that to prevent hybrids from forming, when the flowers appear on an *etrog* tree, they should be fertilized by transferring pollen from one flower on the same tree to another with a small soft brush. However, this may not be an issue, as chromosomal analyses of *etrogim* showed the *etrog* to be a true species, whereas lemons and limes were heterogeneous and clearly were hybrids [12].

Of the four species, the *etrog* is the only one that is edible (Succah 34b, 37b, 45a). A cross section of an *etrog* reveals the following layers. An outer surface consisting of a thin, glossy layer, followed by a thicker yellow or green peel which, although having a harsh taste, can be eaten. Further in, is a thick white rind, occupying most of the *etrog's* volume; considered the "flesh," this is the portion most often consumed. Inside the rind are small pockets containing seeds. In addition to being eaten raw, recipes for *etrog* include pickling in vinegar and boiling to a pulp (Succah 36b). Today, the *etrog* is eaten mainly as a jam or preserve or in the form of a candied peel [13].

There are many Talmudic explanations for the phrase, "the fruit of a *hadar* tree," including that of a tree whose fruit and wood taste the same, which must refer to the . *n* tree (Succah 35a). The fragrant organic volatiles emitted from the etrog fruit and from the leaves of the *etrog* tree are most similar. As compared to other citrus fruits, the *etrog* is the only one that emits a smell without its outer skin being ruptured [14]. In Talmudic times, the *etrog* was used as a perfume (Succah 37b).

Uses of *etrog*, aside from a food product or as a perfume, include as an insect repellant placed among clothes to prevent them from being moth eaten, a preventive for nausea in women approaching childbirth [5], as an aphrodisiac (Yoma 18a,b), as an antidote against a snake bite (Shabbat 109b), and as projectiles thrown at Alexander Yaani, a heretic (Succah 4:9). The inner portions of an *etrog*, when hard, are difficult to digest (Shabbos 108b). More recent studies have shown *etrog* extract to have high antioxidant activity [15], to be of possible relevance for treating diabetes and Alzheimer's disease [16], to inhibit formation of kidney stones [17], to function as a remedy against febrile illnesses [18], and to have antifungal properties [19]. Uzi Eli Chezi, dubbed "the *etrog* man," has a stall in Jerusalem's Machaneh Yehudah, in which is sold various homeopathic medications. A best seller is his *etrog* cream to reduce wrinkles and to improve the overall appearance of skin, making it more bright [20].

The *lulav* of the *arba minim* is from the date palm tree (*Phoenix dactylifera*); the parallel venation pattern on the leaves is indicative of a monocotyledon. The other three species of the *arba minim* are dicotyledons, as indicated by the netted venation on their leaves. Botanically-speaking, the *lulav* is not a branch, but rather is an unopened, pinnated (or, "feathered") leaf, consisting of a central rib from which leaf-like portions spread from either side, similar to the tufts of a feather. Thus, the usual translation, "branches of a palm

tree" (Vayikra 23:40), is incorrect [1].

The palm tree requires a hot climate and is found growing in an oasis in the midst of a desert; wherever the date palm is growing, water must be nearby. For example, when *B'nei Yisroel* left Egypt, one of their first stops was at "*Elim*, and in *Elim* were twelve fountains and seventy palm trees" (Bamidbar 33:9). Aside from Succoth, the date palm tree has many uses. Its leaves are used in wickerwork for rugs and baskets, the fibrous portions of the tree are twisted to form strong ropes or are made into stuffing for mattresses and quilts, and the tree itself is used in the manufacture of boats and furniture [13].

The date palm tree blossoms in spring and yields fruit, i.e., dates, in the summer. As the entire crop ripens simultaneously, the harvest season, known as *gedira* or *gedida*, is relatively short. The unripe green dates which are picked, ripen gradually as they are packed and stored for sale [13]. Dates are one of the seven agricultural species for which *Eretz Yisroel* was blessed. In ancient Israel dates were used to make beer (Devorim 29:5) and honey (Berachot 38a). The phrase, "a land flowing with milk and honey" (Devorim 8:8), refers to date, not to bee, honey (Sifre; Yonathan ben Uziel).

Whereas unripe dates lack nutritional benefits (Berachot 57b) and are unhealthy for nursing women (Ketubot 60b, 65b), ripe dates warm the body (i.e., are an excellent source of energy), satiate, act as a laxative (probably, because of their high fiber content), and strengthen the body (i.e., possibly because of their high content of iron), without adversely affecting the stomach (Ketobot 10b). In additional, the consumption of dates eliminates depression and anxiety (Ketubot 10b), possibly related to their high content of potassium, needed for the functioning of nerves.

The myrtle (*Myrtus communis*) is an evergreen shrub with scented leaves and purple berries. The leaves have a plaited arrangement, overlapping each other in an interlocking pattern to obscure the underlying branch. Arising as units of three from a common point of foliation, the leaves extend vertically. The points of foliation are so close to one another that the wood of the branch is not visible [1]. The leaves are strongly scented when crushed, explaining their use as a perfume by the shepherdess (Shir HaShirim 1:13).

Chemicals derived from myrtle leaves have many medicinal properties, including: (a) to suppress typical pro-inflammatory cellular response [21, 22]; (b) to induce apoptotic death in cancer cells [23], (c) to lower blood glucose levels in type II diabetics [24]; (d) to decrease DNA-damaging effects from exposures to genotoxic chemicals [25]; (e) to protect against oxidative stress [26]; (f) to treat ulcers in the oral cavity [27]; and (g) to exert antibacterial effects [28].

The willow brook tree (*Salix acmophylla*) grows wild along the banks of streams, lakes, and rivers. Characteristics of this plant include its red stems and smooth (i.e., nonserrated), narrow, and pointed leaves. Its quick growth, requiring no attention, symbolizes prosperity, as stated, "They shall grow like willows on brooks of water" (Yeshaya 44:4). The science literature lists only one study with the willow brook tree. As parts of the stem and roots grow submerged in water, the willow brook tree maybe useful in phytoremediation by its ability to accumulate heavy metals from contaminated aquatic systems [29]. In ancient Israel, willow branches, being flexible and easy to manipulate, were used to make wickerwork to make baskets, chairs, huts, and boats [13].

Although there is no scientific information on the health benefits of willow brook, the Rambam noted various remedies using willow brook. Such health benefits included to improve the ability to conceive, to relieve a woman suffering from an irregular menstrual cycle, to restore verbal capacity, to treat disorders of the urinary system, to treat infections of the oral cavity, and as a remedy for burns, rashes, and other dermatological wounds [13].

Interestingly, although the Torah prescribes taking four plant species for their use on *Succot*, no aspect of destruction is involved, rather only tree pruning. Or, in the terminology of today, the Torah suggests, "Go green!"

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REFERENCES

[1] Hirsch, S.R. (1989). The Pentateuch, vol. 3, Leviticus, part II. Judaica Press, Ltd., Gateshead, England.

[2] Schaffer, A. (1982). The agricultural and ecological symbolism of the four species of Sukkot. Tradition 20:128-140.

[3] Oratz, D.(1993). Halachos of the Four Species. Feldheim Publ., NY, NY.

[4] Encyclopedia Judaica Jerusalem (1971). Keter Publ. House, Ltd., Jerusalem, Israel

[5] Goor, A. and Nurock, M. (1968). The Fruits of the Holy Land, Israel Universities Press, Jerusalem, Israel.
[6] Greenspan, A. and Zivotofsky, A.Z. (2005). The extraordinary tale of the etrog. Jerusalem Post, Succot Supplement, pp. 9-11.
[7] Stagemann, S. and Bock, R. (2009). Exchange of genetic material between cells in plant tissue grafts. Science 324:649-651.
[8] Zivotofsky, A.Z., and Greenspan, A. (2008). Mishpacha goes out in search of the perfect esrog. Mishpacha, Succoth issue, pp. 122-125
[9] Nicolosi, E., La Malfa, S., El-Otmani, M., Negbi, M., and Goldschmidt, E.E. (2005). The search for the authentic citron (*Citrus medica* L.): historic and genetic analysis. HortScience 40:1963-1968.
[10] Goldschmidt, E.E. (1976). Factors affecting the shape of citrons. Isr. J. Bot. 25:34-40.
[11] Wiseman, D.M. (1997). The Esrog. Zaide Reuvan's Esrog Farm, Dallas, TX.
[12] Carvalho, R., Soares Filho, W.S., Brasilerio-Vidal, A.C., and Guerra, M. (2005). The relationships among lemons, limes, and citron: a chromosomal comparison. Cytogenet. Genome Res. 109:276-282.
[13] Shaouli, M.C., and Fisher, Y. (1999). Nature's Wealth, Health and Healing Plants, based on the Teachings of the Rambam, Translated by Ruth Steinberg from the Hebrew edition, Beit Knesset Shauli, Ashdod, Israel.
[14] Fleisher, Z. and Fleisher, A. (1996). Ethrog: the first citrus of the Western world. Perfum. Flavor. 21:11-12, 14-16.
[15] Jayapiakasha, G.K. and Patil, B.S. (2007). *In vitro* evaluation of the antioxidant activities in fruit extracts from citron and blood orange. Food Chem. 101:410-418
[16] Conforti, F., Statti, G.A., Tundis, R., Loizzo, M.R., and Menichini, F. (2007). *In vitro* activities of *Citrus medica* L. in Diamente (Diamante citron) relevant to treatment of diabetes and Alzheimer's disease. Phytother. Res. 21:427-433.
[17] Chauhan, C.K. and Joshi, M.J. (2008). Growth inhibition of struvite crystals in the presence of juice of *Citrus medica* Linn. Urol. Res. 36:265-273.
[18] Arias, B.A. and Ramon-Laca, L. (2005). Pharmacological properties of citrus and their ancient and medieval uses in the Mediterranean region. J. Ethnopharmacol. 97:89-95.
[19] Essien, E.P., Essien, J.P., Ita, B.N., and Ebong, G.A. (2008). Physiochemical properties and fungitoxicity of the essential oil of *Citrus medica* L. against groundnut storage fungi. Turk. J. Bot. 32:161-164.
[20] Djlilmand, S.Y. (2008). The esrog man. Mishpacha, Succoth issue, pp. 126-130.
[21] Koeberle, A., Pollastro, F., Northoff, H., and Werz, O. (2009). Myrtucommulone, a natural acylphloroglucinol, inhibits microsomal prostaglandin E(2) synthase-1.Br. J. Pharmacol. 156:952-961.
[22] Rossi, A., DiPaola, R., Mazzon, E., Genovese, T., Caminiti, R., Bramanti, P., Pergola, C., Koeberle, A., Werz, O., Sautebin, L., and Cuzzocrea, S. (2009). Myrtucommulone from *Myrtus communis* exhibits potent anti-inflammatory effectiveness *in vivo*. J. Pharmacol. Exp. Ther. 329:76-86.
[23] Tretiakova, I., Blaesius, D., Maxia, L., Wesselborg, S., Schulze-Osthoff, K., Cinatl, J., Michaelis, M., and Werz, O. (2008). Myrtucommulone from *Myrtus communis* induces apoptosis in cancer cells via the mitochondrial pathway involving caspase-9. Apoptosis 13:119-131.
[24] Sepici, A., Gurbuz, I., Cevik, C., and Yesilada, E. (2009). Hypogylacemic effects of myrtle oil in normal and alloxandiabetic rabbits. J. Ethnophamacol. 93:311-318.
[25] Hayder, N., Abdelwahed, A., Kilani, S., Ammar, R.B., Mahmoud, A., Ghedira, K., and Chekir-Ghedira, L. (2004). Antigenotic and free-radical scavenging activities of extracts from (Tunisian) *Myrtus communis*. Mutat. Res. 564:89-95.
[26] Hayder, N., Bouhlei, I., Skandrani, I., Kadri, M., Steiman, R., Guiraud, P., Mariotte, A.M., Ghedira, K., Dijoux-Franca, M.G., and Chekir-Ghedira, L. (2008). *In vitro* antioxidant and antigenotoxic potentials of myricetin-3-o-galactoside and myricetin-3-o-rhamnoside from Myrtus communis: modulation of expression of genes involved in cell defense system using cDNA microarray. Toxicol. In Vitro 22:567-581.
[27] Babaee, N., Mansourian, A., Momem-Heravi, F., Moghadamnia, A., and Momem-Beitollahi, J. (2009). The efficacy of a paste containing *Myrtus communis* (myrtle) in the management of recurrent aphthoud stomatitis: a randomized controlled trial. Clin. Oral Investig. March 21 [Epub ahead of print].
[28] Alem, G., Mekonnen, Y., Tiruneh, M., and Mulu, A. (2008). *In vitro* antibacterial activity of crude preparation of myrtle (*Myrtus communis*) on common human pathogens Ethiop. Med. J. 46:63-69.
[29] Ali, M.B., Vajpayee, P., Tripathi, R.D., Rai, U.N., Singh, S.N., and Singh, S.P. (2003). Phytoremediation of lead, nickel, and copper by *Salix acmophylla* Boiss.: role of antioxidant enzymes and antioxidant substances. Bull. Environ. Contam. Toxicol. 70:462-469.