



Fasting During Ramadan: Nutrition and Health Impacts and Food Safety Recommendations

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To fast is to “abstain from all or some kinds of food or drink, especially as a religious observance” (Oxford Dictionaries Online 2016). It has been practiced worldwide in some form or other since the time of ancient civilizations and has been used for religious, cultural, and political purposes. Recently, there has been renewed interest in fasting for its dietary and health benefits (Patterson et al. 2015).

Religious fasting has been used for purification, penance, divine revelation, and transcendence, among other reasons. The three major Western religions — Christianity, Islam, and Judaism — all encourage some form of fasting during periods of religious significance (Trepanowski and Bloomer 2010). Islam practices fasting during the month of Ramadan, a 29- to 30-day period in the ninth month of the lunar calendar. This is a period of introspection, communal prayer, and self-restraint from food, drink, and all forms of immoral behavior.

The Muslim-American population is a growing and diverse community. The population includes immigrants and American-born Muslims from a variety of national and cultural backgrounds, including but not limited to the Middle East, North Africa, sub-Saharan Africa, and South Asia. Muslim-Americans make up approximately 2 percent of the total U.S. population, and this is expected to double by the year 2030 (Johnson 2011). Recent surveys show that the Muslim-American population is dispersed and can represent a larger percentage of the population at the county level (Association of Religion Data Archives 2010). These community residents have a potential

need for educational programs that address healthful fasting during Ramadan. It is therefore necessary for Virginia Cooperative Extension and other educational organizations to consider the needs of this population.

Fasting during Ramadan is the abstinence from all food and drink between dawn and dusk. All observing Muslims are obligated to fast during the month of Ramadan, with exceptions for children who have not reached puberty, pregnant and lactating women, the sick and debilitated for whom fasting would be detrimental, and those who are traveling (Bernieh, Mohamed, and Wafa 1994; Kadri et al. 2000). Two meals are consumed daily: one before dawn, known as “sahour,” and one just after sunset, called “iftar” (Al-Hourani and Atoum 2007).

Because the date of Ramadan is based on the lunar calendar, the first day of Ramadan advances 11 days each year in relation to the solar calendar. The consequence is that Ramadan falls in different seasons over a 33-year cycle (Trepanowski and Bloomer 2010). Duration of the fast varies by geographic location and the season in which Ramadan falls. This can result in Ramadan lasting from 12 to 19 hours in a single day (Sakr 1975). There are no restrictions on the foods that can be eaten or beverages consumed before dusk and after dawn beyond those normally prescribed by the religion. The number of meals is usually limited to two per day due to the limited time available to include an additional meal. In keeping with the spirit of Ramadan, this can be a time to make significant changes in lifestyle and to develop resolve to make long-lasting, healthy living choices.

Metabolic Changes During a Dawn to Dusk Fast

The body's response to fasting depends on the length of the fast. Once the body has digested and absorbed all of the food and nutrients from the last meal, which takes eight to 12 hours, the body is in a fasting state and must rely on stored nutrients for energy. The body changes certain hormones to access these stored nutrients, keeping a constant supply of glucose (energy). Insulin, for example, is a hormone that signals body cells to pick up and use glucose from the blood. During a fast, the body produces less insulin and more anti-insulin hormones (glucagon, epinephrine, etc.); this allows the body to access stored energy (glycogen and fat) when energy from food is unavailable. After about 24 hours, a healthy adult will run out of stored glucose sources and begin making new glucose by breaking down protein stores, including muscle tissue (Mahan and Escott-Stump 2000). Fortunately, fasting from dawn to dusk during Ramadan allows for a gentle and normal transition to using glycogen and fats for energy without the undesirable protein breakdown associated with longer fasts.

Diet Composition and Weight Changes During Ramadan Fasting

The vast cultural and geographic diversity across groups observing Ramadan and the resultant variability in fasting time and dietary habits has made it difficult to draw broad conclusions about changes in body weight and diet composition during Ramadan (Trepanowski and Bloomer 2010).

The major change in diet during Ramadan is a reduction in meal frequency. However numerous studies show that people do not tend to reduce the number of calories (amount of energy) they consume daily during the fasting period (Meckel, Ismaeel, and Eliakim 2008). Despite this, a decrease in body weight and body fat is often found in fasting individuals (Mansi and Amneh 2007; Khattak, Bakar, and Yeim 2012). A study of young Jordanian women showed no difference in calorie intake, macronutrient intake, or overall physical activity during fasting. The women still lost weight and body mass index, or BMI, and showed a reduction in body water and body fat percentage (Al-Hourani and Atoum 2007). Similarly,

in a study of Malaysian men, total calorie intake did not change despite an increase in protein and fat intake, yet waist-to-hip ratio decreased after 21 days of fasting. Interestingly, the effect was greatest in normal weight men (Khattak et al. 2013).

A recent report of multiple studies performed in Asia, Africa, North America, and Europe evaluating changes in body weight during Ramadan found that fasting resulted in a significant weight loss averaging 3 pounds in men and women (Sadeghirad et al. 2014). Weight loss was greatest among East Asian populations, and most of the weight was regained within a few weeks after Ramadan. West and East Asian populations showed a reduction in daily calorie intake, while African populations increased their daily calorie intake during Ramadan. Both increases and decreases in calorie intake were due to changes in carbohydrate intake and were related to the culturally distinct traditional foods eaten during this time (Faris et al. 2012).

Effects of Fasting During Ramadan on Metabolic Markers of Health

People who have an illness or health condition of any kind that makes fasting harmful to their health are exempt from fasting at Ramadan, and people with any chronic health condition should check with their physician about the advisability of fasting. The effect of Ramadan fasting on metabolic markers of health has been the topic of many studies with various Muslim populations. A recent review describes the beneficial effects of Ramadan fasting on markers of cardiovascular risk, diabetes and glucose control, and kidney function (Rouhani and Azadbakht 2014).

Cardiovascular Disease

There is evidence that cardiovascular risk factors can improve, specifically the lipid panel, during fasting. Studies have shown a decrease in low-density lipoproteins (LDL or "bad" cholesterol) and an increase in high-density lipoproteins (HDL or "good" cholesterol) during fasting (Adlouni et al. 1997; Nagra et al. 1998). In a more recent report of multiple studies, total cholesterol and triglycerides decreased in men, and HDL increased in women during Ramadan fasting. Both men and women also showed a decrease in LDL cholesterol (Kul et al. 2013). These changes in lipid profile reflect a decrease in cardiovascular risk.

Individuals at risk for cardiovascular disease also showed a significant improvement in 10-year coronary heart disease risk during Ramadan after fasting for at least 10 days (Nematy et al. 2012). In general, these changes in the lipid profile of fasting individuals returned to their previous levels several weeks after Ramadan fasting ended.

Diabetes

Diabetics are at greater risk for hypoglycemia (abnormally low blood sugar) and hyperglycemia (abnormally high blood sugar) during periods of fasting (Salti et al. 2004). People with diabetes who need insulin to control their diabetes are advised not to fast or to do so under the supervision of a physician who can appropriately monitor and adjust insulin delivery. Insulin delivery should be rescheduled according to the change in meal timing during Ramadan, and the use of an insulin pump is recommended (Khalil et al. 2012). People with diabetes who do not require insulin and have their blood sugar under control either by diet or oral medication should also consult with a physician prior to fasting because changes to their oral medication due to the altered eating pattern could be required.

Studies have shown that fasting blood sugar and postprandial (after a meal) blood sugar is decreased among Type 2 diabetic patients during Ramadan. Overall glycemic control appears to be improved during Ramadan (Vasan et al. 2012; Al-Shafei 2012). In addition to improved blood sugar control, improvements in lipid profile and inflammatory markers are also noted. Although the fasting blood sugar and lipid changes return to prefasting levels several weeks after the end of the fast, the decreased inflammatory markers persist for a longer period of time (Al-Shafei).

Moderation in carbohydrate and fat intake during the evening meal and the inclusion of complex carbohydrates in the predawn meal are recommended for diabetics. It is important that people with diabetes who want to fast during Ramadan receive medical, nutritional, and physical activity counseling prior to the fast. Additionally, diabetics should know that if they experience significant hypoglycemia during fasting, they need to break the fast to address the hypoglycemia.

Kidney Function

Due to the total restriction of food and fluids from dawn to dusk during Ramadan, dehydration is a concern. Studies have shown that total water intake decreases during Ramadan. The body responds by decreasing the output of urine and increasing urine concentration. By the third week of Ramadan the fluid deficit is the greatest, but it is usually corrected by the end of the month. This may be less of a complication in humid and cooler climates (Roky et al. 2004). If proper attention and care is not taken to ensure rehydration during nonfasting hours, dehydration can be a serious complication and can even be fatal (Whitney et al. 2008). If serious symptoms of dehydration occur — including dizziness, lethargy, muscle cramps, disorientation, or fainting — immediate steps should be taken to provide fluids to correct the dehydration.

Despite the increased need for the body to concentrate urine during Ramadan, kidney function and urine output are not impacted negatively in healthy individuals. Concern exists, however, about the impact of fluid restriction for individuals with chronic kidney disease. Though not conclusive, some evidence indicates that damage to the renal tubular cells can occur in those with chronic kidney disease during fasting (Emami-Naini et al. 2013; El-Wakil et al. 2007). Despite this, the beneficial effects of fasting on body weight, blood pressure, triglycerides, and glomerular filtration rate could outweigh the risk in individuals with various stages of chronic kidney disease (Bernieh et al. 2010). Individuals with chronic kidney disease should be monitored by a physician if they choose to fast.

Fluid restriction can impact individuals with kidney stone disease as well, though the evidence is inconclusive. Although some studies have shown an increase in kidney stone formation in the first weeks of Ramadan and an association between kidney stone formation and Ramadan fasting (Abdolreza et al. 2011), numerous other studies have shown no association between the two (Al-Hadramy 1997; Basiri et al. 2004; Miladipour et al. 2012). Individuals with a history of kidney stones who choose to fast during Ramadan should pay special attention to their fluid intake and drink adequate amounts of water from dusk to dawn to attain the recommended 24-hour urinary volume.

Pregnancy and Fasting During Ramadan

Women who are pregnant or lactating are not required to fast during Ramadan. If a woman feels strong and healthy and would like to fast, especially during the early part of pregnancy, she should consult her obstetrician to determine whether it is safe. It is important to consider the impact of fasting on the developing infant. Current evidence suggests that fasting under the conditions described above for pregnant women can be done safely.

Young pregnant Iranian women who fasted an average of 13 days saw no difference in the incidence of infants born with low body weight, the duration of pregnancy, or the intrauterine growth of infants (Ziaee et al. 2010). A larger study that compared pregnant women who fasted to those who did not (402 women total) found no difference in birth outcomes. In addition, the women who fasted had lower rates of cesarean section delivery. Infants of fasting mothers had a lower average birth weight, however (Awwad et al. 2012).

Some limited epidemiological evidence exists of lower weight and height in adults whose fetal period was during Ramadan. A recent population-based study compared Muslim adults whose fetal period was during Ramadan to Muslim adults whose fetal period was not during Ramadan. This study showed that those whose development took place during Ramadan were thinner and shorter. A similar comparison of non-Muslim adults found no significant differences (Van Ewijk, Painter, and Roseboom 2013).

Physical Activity and Athletics

People who are sedentary or exercising with low to moderate intensity can often continue their usual physical activity routine with a few adjustments to activity times and intensity. Fasting is more complicated for competitive athletes. Beyond the change in eating and drinking patterns that occur, Ramadan fasting can cause changes in circadian rhythms (sleep/wake cycles), metabolism, and hormonal secretions. These changes — along with sleep deprivation — can impact athletic performance. Despite this, disciplined athletes can safely continue their training during Ramadan (Shephard 2013).

Athletes can experience decreased performance and increased fatigue during the fasting days of

Ramadan. A study of middle distance runners who continued training during fasting showed a decline in maximum aerobic velocity and an increase in fatigue (Chennaoui et al. 2009), while a study of adolescent soccer players showed a decline in various parameters of performance even though total caloric intake and sleeping time were unchanged (Meckel, Ismaeel, and Eliakim 2008). Similarly, the endurance capacity of professional soccer players has been shown to be reduced during Ramadan (Zerguini et al. 2007).

There are advantages and disadvantages to different training times; however, it is possible for athletes to continue training at all times of the day with appropriate precautions. Evidence exists that the optimal time to exercise for improved performance and retention of body fat for intense aerobic exercise is in the evening after breaking the day's fast (Aziz et al. 2012; Trabelsi et al. 2012). This is the time of peak physiological and psychomotor performance, and adequate protein and carbohydrate are available for positive protein balance and recovery of glycogen stores (Atkinson et al. 2007; Shephard 2013). To minimize the effects of fasting on training and athletic performance, athletes should aim to get enough sleep; adjust the diet to ensure appropriate intake of calories, protein, and carbohydrates; and monitor themselves closely for chronic dehydration (Shephard).

Potential Benefits of Fasting During Ramadan

Fasting in the month of Ramadan is both a physical and spiritual exercise for those who observe it. It is an opportunity to address one's life holistically, including a heightened consciousness of spiritual matters, concern for community, and personal lifestyle behaviors and attitudes (Mahroof et al. 2007). It can be a time to make significant changes in lifestyle behaviors and to develop the resolve to make healthy decisions that can include dietary choices. Programs that prepare individuals planning to observe Ramadan to make healthy dietary choices during this time of introspection can have an impact on their dietary behaviors for their lifetimes.

Tips for a Healthy Ramadan

Planning appropriate sleep, dietary intake, and hydration are important during fasting. Sleep is often delayed, and deep sleep time decreased during

Ramadan. More than half of adults sleep less during Ramadan. This may contribute to changes in cognitive function in youth, and it is a major contributor to daytime working difficulties seen in adults during fasting, even more so than thirst or hunger (Farooq et al. 2015) — this can impact academic and work performance. People should avoid unnecessary sleep delays and get as much quality sleep as possible during Ramadan.

A balanced diet with an appropriate amount of calories, vitamins, minerals, and fluids — especially water — is important to prevent muscle breakdown, support physical activity and health, and prevent dehydration. The healthy eating pattern presented in the Dietary Guidelines for Americans (USDHHS and USDA 2015) and depicted in MyPlate is a flexible, healthful diet guide and can be used during Ramadan to plan nutritionally adequate meals and snacks. The following dietary tips are recommended:

- Eat sufficient portions of fruits and vegetables (5-10 servings daily or half the serving plate).
- Make complex carbohydrates the major source of carbohydrate in the diet. Grains are a good carbohydrate source. Whole grains should make up at least half of grain intake because they are more nutritious and slow digestion.
- Eat protein foods daily and choose lower fat options, including fish at least two times a week. Include healthful plant proteins, such as beans, legumes, nuts, and seeds.
- Use healthy oils for cooking, including olive, canola, and other polyunsaturated oils. Avoid excessive fat intake, solid fats, and those containing trans fatty acids.
- Include low-fat dairy products in the diet daily, including low-fat and nonfat milk, yogurts, and cheeses.
- Drink sufficient fluids daily to maintain normal hydration, emphasizing water and limiting those that contain sugar and are known diuretics, such as coffee, soda, and black tea.

Following are specific recommendations for foods to consume at the suhoor (predawn) and iftar (postdusk) meals:

- Suhoor should be a moderate-size meal; there is no need to overconsume foods. It should be filling and contain foods that will provide energy for a number of hours. Eating whole grains and protein, fruits and vegetables, plenty of water, and some fat/oil will delay digestion and prolong satiety.
- Iftar traditionally begins with dates, fruits, 100 percent fruit juices, and tea. Have a healthy, balanced dinner in the early evening. There is no need to overeat.

Other general recommendations include

- Avoid heavily processed foods that contain refined carbohydrates; fried foods; and high-sugar, high-fat foods and pastries.
- Consume plenty of liquid, particularly water, by bedtime to ensure proper hydration (Mahroof et al. 2007).

Food Safety Considerations During Ramadan

Muslims often come together as families or part of the broader community to eat together in the morning and observe the breaking of the fast (Ghouse 2008; Katz 2003). Communal gatherings are common at family homes, community centers, or mosques. With food as a central element in these events, safe food handling is an important health consideration.

Each year in the U.S., there are approximately 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths linked to foodborne illness (Scallan et al. 2011). In Virginia, 20 foodborne illness outbreaks were reported in 2013; an average of 18 Virginia residents were sickened per outbreak, with a range of one to 115 per outbreak. Multiple etiologic agents were confirmed, including *Salmonella* species, norovirus, *Staphylococcus aureus*, and *E. coli* bacteria (Virginia Department of Health 2014).

Community events such as dinners, fundraisers, and wedding receptions are common sources of foodborne illness outbreak (Castel et al. 2005; Chapman 2013; Olson, Edson, and Sewell 1997; USDA 2011; Wilson 2015). Food safety recommendations outlined in *Cooking for Crowds* or *Cooking for Groups* curricula (Penn State 2005) have a direct application to food safety during Ramadan. Food specialties vary

across cultures and regions, as do traditions that can influence food safety behaviors (Taylor 2011; Aljoudi, Al-Mazam, and Choudhry 2010). Those who educate food handlers are encouraged to engage class participants and learn how food specialties are handled.

Recommendations for food safety at Ramadan events follow.

Planning

- Assign a person to be in charge of contacting the local health department about food event rules and regulations; overseeing volunteers; and supervising preparation, service, and cleanup.
- Determine the menu and ensure that access to the proper equipment is available.
- Make sure a potable water source is available for outdoor events.
- Plan how to transport equipment for cleanup.
- Make sure that adequate space is available in refrigerators and freezers.

Purchasing and Transporting

- Do not purchase dented, leaking, bulging, or rusted canned goods.
- Purchase foods, including halal meat, from reputable suppliers.
- Separate raw meat, poultry, and seafood from other foods in the cart.
- Purchase perishable foods last.
- Use a cooler during transportation if possible.
- Limit the number of stops after purchasing to ensure the prompt return of perishable foods to cold temperatures.
- Keep foods at safe temperatures by following the temperature storage requirements provided; they apply during transportation of foods as well as storage before, during, and after events.

Storing

Because bacteria multiply rapidly between 40 and 140 degrees Fahrenheit, care must be taken to avoid letting foods remain in this temperature range.

- Keep cold food below 40 F by storing in the refrigerator, cooler, or on ice.
- Keep hot food above 140 F in heated chafing dishes, steam tables, warming trays, or slow cookers.
- Freeze or refrigerate perishable foods, prepared foods, and leftovers within two hours if no temperature control is applied. If ambient temperatures are over 90 F, freeze or refrigerate within one hour.
- Store raw meat, poultry, and seafood in containers to prevent raw juices from dripping onto foods. Do not store these products above ready-to-eat foods, such as salads.

Cleaning and Sanitizing

- Wash hands before food preparation begins and between each food item.
- Wash cutting boards, dishes, utensils, and countertops with hot, soapy water. Rinse.
- Sanitize using a fresh solution of 1 tablespoon unscented liquid bleach in 1 gallon of water.

Preparing

- Wash hands often with soap and warm water for 20 seconds before and after handling food and after handling chemicals (e.g., cleaners and sanitizers), using the bathroom, changing diapers, handling pets, taking out trash, wiping noses, and any other event that could contaminate hands. Use paper towels to dry hands.
- Marinate foods in the refrigerator, not at ambient temperatures. Do not reuse marinades for other foods without boiling it first.
- Use a clean utensil each time if tasting food during preparation.

Thawing

- Do not thaw foods at room temperature.

Thaw foods in the refrigerator, in the microwave (but only if the food is cooked immediately), under constantly running cold water (70 F or colder), or as part of the cooking process.

Cooking

- Measure the internal temperature of meat, poultry, casseroles, and other food using a calibrated food thermometer that is cleaned and sanitized for each use. Oven-safe, dial instant-read, and digital instant-read thermometers are available. Follow the manufacturers' instructions.
- Cook food to the following safe minimum internal temperatures:
 - Eggs - cook until yolk and white are firm.
 - Egg dishes, egg sauces, and custards – 160 F.
 - Ground turkey or chicken – 165 F.
 - Ground beef, veal, or lamb – 160 F.
 - Fresh cuts of beef, veal, or lamb – 145 F with a three-minute rest time after removing from heat.
 - Commercially cooked, vacuum-sealed, and ready-to-eat roast beef – 140 F.
 - All poultry products and stuffing – 165 F.
 - Sauces, soups, gravies, and marinades that are used with raw meat, poultry, or fish: boil.
 - Seafood – 145 F.
 - Leftovers and casseroles – 165 F.

Serving

- Use clean containers and utensils.
- Keep cold food cold and hot food hot by following the storage temperature and storage requirements listed above.
- Discard all perishable foods that are stored at room temperature longer than two hours. If ambient temperatures are over 90 F, discard perishable foods after one hour (USDA 2011).

Additional Considerations

Interpretation services are available for Virginia Cooperative Extension faculty and staff to assist clients. Call 1-800-CALL-CLI or contact the VCE Civil Rights Compliance team.

It is recommended that VCE clients and staff seeking information on halal slaughter practices, meat processing, and local providers contact their county agriculture and natural resources Extension agent.

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