Ramadan Fasting and Saliva Characteristics: A Review

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Abstract

Ramadan fasting is the absence of swallowing or limiting food and drink for a certain period, usually having a duration of between 28 and 30 days with an average period of 12 hours. One of the first biological fluids to experience changes in eating habits and changes to the environment or physics in the oral cavity during fasting is saliva. Changes that can occur are a decrease in saliva production which will result in a decrease in the function and components of saliva in the oral cavity. The purpose of writing this review is to determine the effect of fasting on saliva characteristics. This Literature Review was prepared using various sources, most of which are within the last 5-10 years. The literature search used as a data source used Google Scholar and PubMed. The keywords used are "saliva", "fasting", "ramadan fasting", "salivary flow", "saliva composition", "biochemistry of saliva". Changes in saliva characteristics during fasting include a decrease in saliva flow rate, complaints of dry mouth or xerostomia as well as changes in saliva composition, namely a decrease in inorganic components of saliva such as phosphate and calcium. During Ramadan fasting there is a risk of decreasing flow rate which in turn can affect the condition of the oral cavity.

Keywords: fasting, Ramadan fasting, saliva composition, saliva biochemistry

INTRODUCTION

Ramadan is the ninth month of the Islamic lunar calendar (Hijra) which has great significance for all Muslims in the world. During the month of Ramadan, Muslims fast every day from dawn to sunset. The definition of fasting is the absence of swallowing activities or limiting food and drink for a certain period, usually having an intermediate duration. between 28 and 30 days on a 12 hour average period. Apart from refraining from eating and drinking, consuming oral medications or intravenous nutritional fluids is also not permitted while fasting. Saliva is the first biological fluid to experience changes in eating habits as well as changes to the environment or physical environment in the oral cavity during fasting. One of the changes that can occur is a decrease in saliva production which will result in a decrease in the function and components of saliva in a person's oral cavity.

Fasting can cause changes in the oral cavity such as changes in oral hygiene and changes in microflora. This is because the time and amount of food intake is different from normal. The complex relationship between diet and microflora in the oral cavity can lead to caries and periodontal disease. Saliva is the first biological fluid to experience changes in eating habits as well as physical or environmental changes during fasting. Saliva can influence oral health through specific and nonspecific chemical-physical properties. Saliva has an important role because of its very protective functions against harmful agents such as microorganisms, toxins and various oxidants. Saliva is the first biological fluid to experience changes in eating habits as well as physical or environmental changes during fasting. Saliva can influence oral health through specific and nonspecific chemical-physical properties. Saliva has an important role because of its very protective functions against harmful agents such as microorganisms, toxins and various oxidants. The role of saliva is to help mastication by forming a bolus with mucin, aiding
Digestion because it contains the amylase enzyme, tissue repair because it contains growth hormone, self-cleaning by cleaning bacteria and debris, maintaining tooth integrity and protecting the surface because it forms a pellicle, antimicrobial function because it contains lysozyme, histatin, ferritin, statherin and Immunoglobulin A (Ig A) and maintain saliva pH with the ability of the buffer system. The flow rate and composition of saliva are reported to vary from person to person. Factors that influence include age, gender and fasting conditions. In fasting conditions, it is reported that the flow rate and composition of saliva will decrease. Apart from refraining from eating and drinking, consuming oral medication or intravenous nutritional fluids is also not permitted while fasting. Saliva is the first biological fluid to experience changes in eating habits as well as changes to the environment or physics in the oral cavity during fasting. One of the changes that can occur is a decrease in saliva production which will result in a decrease in the function and components of saliva in a person's oral cavity. The purpose of writing this review is to determine the effect of fasting on saliva characteristics.

**METHOD**

The literature search used as a data source used Google Scholar and PubMed. The keywords used are "saliva", "fasting", "ramadan fasting", "salivary flow", "saliva composition", "biochemistry of saliva".

This Literature Review was prepared using various sources, most of which are within the last 5-10 years. In this step in preparing a literature review, the technique used is a literature study technique by searching for sources or literature in the form of international journals. The inclusion criteria for this literacy search were English language journals.

**DISCUSSION**

**Overview of Saliva**

Saliva is a complex oral fluid consisting of a mixture of secretions from the major and minor salivary glands in the oral cavity. Saliva mostly contains water (99.5%), inorganic protein (0.3%), and other substances (0.2%). Salivary secretion can be influenced by several factors, including chemical, mechanical and neural stimuli. Salivary secretion is different for each individual, but the normal rate of secretion ranges from 500-1500 ml, while the flow rate for unstimulated saliva for each individual ranges from 0.3-0.5 ml/minute and the stimulated saliva flow rate reaches 10 ml/minute.

Salivary glands can be classified based on their size, namely major and minor salivary glands or based on the histochemical nature of saliva secretion, namely serous, mucous, or mixed. Serous saliva is a watery saliva secretion while mucous saliva is a thicker saliva secretion. There are three paired major salivary glands, namely the parotid gland, submandibular gland and sublingual gland. There are ducts/channels that will transport and modify saliva before the saliva is excreted in the oral cavity. Stensen's duct is the main excretory duct of the parotid gland located in the buccal mucosa near the maxillary second molar. Wharton's duct is the main excretory duct of the submandibular gland, located under the tongue. The sublingual gland has small ducts called Rivinus' ducts and Bartholin's ducts which connect with Wharton's ducts at the sublingual caruncula. The minor salivary glands are distributed throughout the oral cavity in the buccal and labial mucosa, posterior palate, and labial border of the tongue. The minor glands of the palate and dorum of the tongue are mucous like the anterior lingual glands.

**Saliva composition**

The main bio(organic) component of saliva is protein. There are other components, such as fatty acids, lipids,
glucose, amino acids, urea, and ammonia. Apart from coming from the salivary glands themselves, these products partly come from food waste and exchange of bacterial substances. Proteins that are quantitatively important are α-amylase, proline-rich protein, mucin, immunoglobulin, lysozyme, lactoferrin, gustin.

1) The α-amylase protein has the function of converting glycogen into smaller carbohydrate units.

2) Proteins rich in proline have an important function in forming the main part of the young pellicle in tooth enamel and can coagulate certain bacteria so that they cannot live in the oral cavity.

3) Lysozyme has the function of killing bacteria, so it has an important role in the bacterial rejection system.

4) Mucin has the function of making saliva more concentrated so that it is not runny like water and can protect the mouth from dryness.

5) Immunoglobulin has a function against a specific rejection system.

6) Lactoferrin has the function of binding Fe3+ ions which are used for bacterial growth.

7) Gustin has a function in the process of taste awareness.

Potential of hydrogen (pH) of Saliva

A degree of acidity in a solution is often called pH. pH is used to measure the acidity level of a solution. The pH level in saliva depends on the ratio between the acid and its base conjugate in question. The lower the pH value, the higher the acidity level of a solution. The pH of total saliva at rest is usually more acidic than stimulated saliva, namely around 6.4-6.9. If the pH of saliva is below 5.5, it will be very dangerous for tooth enamel and can cause tooth demineralization.

When the oral cavity is acidic, the pH of plaque will decrease within 1-3 minutes to a pH of around 4.5-5.0. Then after 30-60 minutes the pH will return to normal. There are several factors that can influence changes in saliva, including the average speed of saliva flow, the buffer capacity of saliva, and the microorganisms in the mouth. The condition of the oral cavity which has a low pH of around 4.5-5.5 will facilitate the growth of acidogenic bacteria, namely Streptococcus mutans and Lactobacillus. Streptococcus mutans is a bacteria that plays a role in the initial process of caries, while Lactobacillus is a bacteria that plays a role in the process of caries development and continuation. In the oral cavity there are also Veillonella bacteria, these bacteria are considered capable of inhibiting the process of dental caries. After eating, the pH of saliva will decrease and the concentration of bicarbonate ions will increase. The decrease in pH is caused by an increase in H+ ions in plaque, because bacteria will ferment carbohydrates into lactic acid. When eating, the flow rate of saliva will increase bicarbonate which is first produced as a byproduct of cell metabolism which diffuses into dental plaque and helps neutralize the increased amount of acid produced by bacteria. Salivary pH increases with increasing bicarbonate concentration. A saliva pH value of 5.5 needs to be avoided because it can cause erosion of calcium salts in the enamel which will cause tooth erosion. Several salivary proteins, phosphate, and bicarbonate contribute to salivary pH. The acid formed under plaque is ready to be converted into bicarbonate in saliva which is ready to break down and be released as carbon dioxide. When examined, such acidic conditions have a pH value below 5.5. Saliva will become thicker due to a decrease in pH. Intra-oral pH can decrease due to excessive consumption of acidic foods and drinks, so this condition can cause tooth erosion. Prolonged cleansing and drinking methods should be avoided as they cause a prolonged decrease in intra-oral pH. Oral pH often decreases in individuals with bulimia and gastro-oesophageal reflux disease (GORD), especially on the palatal surfaces of the
maxillary teeth. Intraoral pH is influenced by many intrinsic and extrinsic factors, where they interact with each other in the process of tooth erosion. Tooth wear is caused by a combination of erosion, friction, abrasion and abfraction, with these mechanisms often acting synergistically, sequentially or additively. Multifactorial etiology makes it difficult to identify the primary cause of tooth wear.\textsuperscript{15}

**Salivary buffer capacity**

The buffer capacity of saliva is a buffer system that acts to resist changes in pH. The salivary buffer components involved are dihydrogen phosphate/hydrogen phosphate and carbonic acid/bicarbonate. Bicarbonate is the main buffer component in saliva that is responsible for neutralizing acids. The bicarbonate concentration in stimulated saliva is approximately 28 mM and varies among individuals. Its concentration in stimulated saliva is also reported to be 12 times higher than in unstimulated saliva.\textsuperscript{15}

Bicarbonate (HCO\textsubscript{3}) in saliva reacts with hydrogen ions (H\textsuperscript{+} from acids). Through reactions, it removes protons to produce carbonic acid (H\textsubscript{2}CO\textsubscript{3}). H\textsubscript{2}CO\textsubscript{3} is then converted into carbon dioxide gas (CO\textsubscript{2}) and water (H\textsubscript{2}O) by the carbonic anhydrase enzyme in saliva. CO\textsubscript{2} gas will then diffuse into the environment, due to the difference in partial pressure of CO\textsubscript{2} in saliva and the environment.\textsuperscript{16}

The dihydrogen phosphate buffer system works in the opposite direction, with higher concentrations (5 mM) in unstimulated saliva compared with when stimulated (3 mM), but it plays a minor role in the total buffering capacity of saliva.\textsuperscript{15} Saliva also contains proteins that act as buffers. The ability of a protein to buffer depends on its amino acid structure. When a protein is in a solution, the amine (NH\textsubscript{3}) and carboxyl (COOH) groups can lose or gain hydrogen ions, depending on the pH of the solution. Although saliva has many protective properties, its role is limited when faced with large amounts of strong acids. Frequent and large amounts of strong acid can easily displace the obtained salivary pellicle, which is usually about 1 \mu m. The residual volume of saliva in the mouth is approximately 0.8 mL therefore not enough to dilute a mouthful of sour drink.\textsuperscript{15}

**Types of Fasting**

Fasting is defined as partial or total abstention from all foods, or specific abstention from prohibited foods. Fasting has been the subject of much scientific research, as it is a potential non-pharmacological intervention to improve health and increase longevity.\textsuperscript{17} In humans, fasting is done by ingesting as little as possible of high-calorie foods and drinks for a typical period ranging from 12 hours to three weeks. There are many religious groups who perform fasting in their religious rituals, including Muslims, they will fast from dawn to dusk during the month of Ramadan. Other religions that practice fasting include Christians, Jews, Buddhists, and Hindus, who traditionally observe fasts on designated days of the week or yearly calendar. Fasting is different from calorie restriction, where calorie intake will be chronically reduced by 20%-40% but the frequency of eating is maintained. There are findings from well-controlled investigations in experimental animals and humans, indicating that fasting may provide an effective strategy for reducing body weight, delaying aging, and optimizing health.\textsuperscript{2} There are various types of fasting, including\textsuperscript{18}:

1. Complete alternate-day fasting

   This fast is fasting on alternating days with a daily eating schedule. In this type of fasting there is no food or drink that contains energy to be consumed. In 2007, Varady & Hellerstein reviewed alternative fasting studies in mice and concluded that it was as effective as simple calorie restriction in reducing obesity-related weight gain, insulin concentrations, and fasting glucose.

2. Modified fasting regimens
This type of fasting allows you to consume 20%–25% of your energy requirements on your scheduled fasting day. This fasting is usually carried out on people who follow a food diet with a ratio of 5:2, where the person will limit energy intake on 2 consecutive days and eat optionally for the remaining 5 days during the week. Results from a small number of intervention trials on fasting suggest that this eating pattern results in weight loss.

3. Time-restricted feeding

This fasting allows for optional energy intake within a certain period of time. Studies of eating <3 times per day are indirect examinations of periods of daily fasting or fasting at night. In subjects who fast only eat once a day, the will complain of higher levels of hunger in the morning. This fasting was considered acceptable among the people because there were no significant changes in measurements of tension, depression, anger, strength, fatigue, or confusion.

4. Religious fasting

This fast is a fast carried out for religious purposes or to provide physical benefits.

5. Ramadan fasting

This fast is carried out from sunrise to sunset and is carried out during the holy month of Ramadan. The most common dietary practice is to consume one large meal after sunset and one light meal before dawn. Apart from that, fluid intake, smoking and drugs are also prohibited when fasting begins. The length of time of fasting depends on the geographic location of those fasting, it can vary from 11 hours of fasting to 22 hours of fasting. Islamic fasting during the month of Ramadan does not require energy restrictions. However, as food and fluid intake becomes less frequent, weight changes may occur.

6. Other religious fasting

Members of the Church of Jesus Christ routinely abstain from food and drink for long periods of time. Some seventh-day Adventists will consume their last two daily meals in the afternoon, then they will fast at night for an extended period of time which may be of biological importance.

The Muslim fast during the month of Ramadan is observed worldwide by millions of Muslims. For one whole month, Muslims observe intermittent fasting from dawn to dusk. Islam has more than a billion followers worldwide, so it can be assumed that several hundred million people observe the Ramadan fast every year. The experience of fasting teaches Muslims to be more self-disciplined and self-controlled and allows them to empathize with those who are less fortunate, suffering and poor. This fast is not obligatory for children, menstruating women, sick people, and travelers. Pregnant and breastfeeding women will be exempted and allowed to postpone their fast.

Changes in characteristics and composition of saliva during fasting

Fasting is characterized by changes in the schedule and frequency of meals. Dietary changes that can change include changes in consumption times to diets rich in carbohydrates. Additionally, not consuming water for long periods can bring about changes in normal body physiology. Other changes that may have an effect are lifestyle including reducing hours of sleep, eating frequency, and reducing physical activity.

Halitosis can be a common complaint among people who fast because during fasting conditions there will be a decrease in saliva concentration and an increase in the concentration of volatile sulfur compounds. An increase in the concentration of sulfur-containing compounds in the oral cavity and a decrease in the concentration in saliva can cause malodor which is characterized by halitosis. This can be caused by errors related to poor oral hygiene practices or oral disease. This odor can be reduced by proper debridement with toothpaste or miswak when breaking the fast. Research results show that dental caries, periodontal disease and other oral
pathologies are complex disorders that arise from the interaction between diet and the natural oral microflora present in the oral cavity, considering that the fasting period in the holy month of Ramadan will result in changes in dietary food intake. Apart from that, xerostomia is also a condition that is often experienced by individuals when fasting. Xerostomia is a subjective or objective feeling of dry mouth caused by the activation of the thirst reflex, usually associated with a decrease in the rate of saliva flow from the salivary glands. When fasting, the water concentration in the body will decrease. Water in the body is lost through urine, feces, and transcutaneous water loss in the form of involuntary sweat. During the day when fasting Muslims are prohibited from consuming water, therefore fasting people complain of dehydration conditions such as dry mouth, headaches, fatigue, dizziness and nausea. The level of dehydration felt by individuals can vary. Research conducted by Selviani et al. have shown a relationship between dehydration and a decrease in sodium concentration during fasting. This is because the inorganic components of saliva are related to the rate of saliva flow. The decrease in saliva flow rate is also accompanied by a decrease in phosphate and calcium concentrations during fasting.

CONCLUSION

Ramadan fasting requires changes in eating patterns which include changing the time of consumption to a diet rich in carbohydrates. Additionally, not consuming water for long periods can bring about changes in normal body physiology. Other changes that may have an impact are lifestyle including reducing hours of sleep, eating frequency, and reducing physical activity. Changes in the oral cavity that can occur during fasting include changes in saliva flow rate, complaints of dry mouth or xerostomia as well as changes in inorganic components such as phosphate and calcium which ultimately affect the overall condition of the oral cavity.

REFERENCE


