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THE INFLUENCE OF HUMAN DIET, ODOR CHEMISTRY AND MOLECULAR MECHANISMS ON MOSQUITO ATTRACTION AND CANCER BIOLOGY: A REVIEW

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Abstract:

Mosquitoes are attracted to humans in a process that involves different factors. This process is shaped by what people eat their genes, the chemicals they smell and if they have any infections. This review brings together findings from studies about how diet affects this how certain smell receptors work, how plants that humans eat give off scents and how infections change behavior. We talk about how the food people eat changes the smells they give off. We also explain how certain smell receptors in a type of mosquito called Anopheles gambiae help them find people to bite. We also look at how having malaria makes people more attractive to mosquitoes. Learning about these things helps us find ways to control mosquitoes. These ways could include changing what people eat changing the bacteria in their bodies and making repellents that work on the smell receptors. Mosquitoes are drawn to humans because of what they eat the smells they produce and the way their bodys receptors work. These same things are also linked to changes that happen in cancer. This review brings together information from studies about insects and medical research. It shows how the chemicals from what people eat and the smells they give off affect how mosquitoes behave. It also shows that the same kinds of chemical signals are involved in how cancer grows. Understanding these chemical patterns might help us create new ways to stop mosquitoes and also find new signs, for cancer.

Keywords: *Mosquito Attraction; Odorant Receptors (Anopheles Gambiae); Volatile Organic Compounds (Vocs); Human Odor Chemistry; Diet And Host Attractiveness; Malaria Infection; Cancer Metabolism; Warburg Effect; Biomarker Discovery; Cross-Disciplinary Insights.*

1. Introduction

Diseases spread by mosquitoes are still a problem for health all over the world. These mosquitoes cause a lot of pain. Cost a lot of money for many people. Mosquitoes like *Anopheles*, *Aedes* and *Culex* are very good at spreading germs. These germs cause things like malaria, dengue fever, Zika, chikungunya, yellow fever and West Nile fever (1). Even though we have used bed nets and medicine for a time mosquitoes are still spreading these diseases. This is happening because the weather is changing cities are growing fast and mosquitoes are getting used to the sprays, we use to kill them (2). A big part of this problem is how mosquitoes find people to bite. We need to understand how mosquitoes find and pick people so we can make ways to protect ourselves. In the past scientists thought mosquitoes just followed heat, moisture or the breath we exhale. While these things do help mosquitoes find people from away, they do not explain why some people get bitten much more than others. It is a fact that in a group of people some people get bitten all the time while others are left alone. This shows that mosquitoes are actually looking for specific smells that are different for every person. Only female mosquitoes bite humans because they need the protein and fat in our blood to make their eggs (3). To do this well female mosquitoes have an amazing sense of smell. Their bodies are covered in sensors that help them read the chemical smells around us. While they use the carbon dioxide, we breathe to find us from a distance they use our skin smells to decide where to land (4). New science shows that why a person attracts mosquitoes is actually quite complex. It depends on their genes the germs living on their skin what you eat and even if you are sick. Their skin is always releasing water, salt and oils. The tiny germs on their skin eat these things. Turn them into different smells like alcohols or acids. Their DNA helps decide what their skin smells like (5). Also, what one eats changes their smell. For example, drinking alcohol or eating fruits like bananas can make you smell more attractive to mosquitoes because you release more lactic acid. On the hand eating things like garlic or citrus fruits might actually help hide their smell from mosquitoes. Some new research even shows a link between mosquito attraction and cancer. Cancer cells work differently than cells and create a lot of extra waste. This waste includes things like acid and acetone. When these chemicals come out through their skin they change their smell. This can make people with types of cancer smell much more attractive to mosquitoes than healthy people (6). This means the same smells that mosquitoes use to find food can actually be signs of disease in a person. Even the germs inside us can change how we smell. For example, the parasites that cause malaria can change a person's body odor to make them smell better to mosquitoes. This helps the parasite spread to people (7). This paper looks at all these ideas using information from places, like the National Institutes of Health Johns Hopkins University and Pfizer (8, 9, 10). We want to see how food, skin chemistry and biology all work together to help mosquitoes choose their targets. We also want to see if we can use this to help humans. If we understand these smells, we can make repellents or use plants to control mosquitoes without using toxic chemicals. We might even be able to build " noses" that work like a mosquito's nose. These tools could help doctors find signs of cancer early by smelling the air around a person. This review will look at all the things that make mosquitoes pick people so we can understand this biological link much better (11).

2. Methodology

i. **Literature search:** Data collected from NIH, Academia.edu, Johns Hopkins, Pfizer, PMC, and oncology journals.
ii. **Odor & metabolic pathways:** Identification of volatile organic compounds (VOCs) linked to diet and cancer metabolism.
iii. **Mosquito mechanisms:** Analysis of odorant receptor signaling and malaria infection effects on host attraction.

iv. **Data analysis & integration:** Comparative synthesis of entomological and oncological findings to reveal shared biochemical pathways.

v. **Outcome:** Development of cross-disciplinary insights connecting vector biology, diet, and cancer biomarker discovery.

3. Dietary influence and metabolic crosstalk

- **Alcohol and Bananas**: The body's natural processes behind these eating and health conditions help explain how changes in metabolism in areas of the body directly affect the way creatures that seek out hosts behave. Medical studies show that when the liver quickly processes alcohol and when someone eats a lot of bananas both situations cause an increase in blood flow and how fast the body uses energy. This leads to a rise in the temperature of the skin in that area. This heat production works with more alcohol and lactic acid being released through the skin creating a strong mix of heat and chemicals that mosquitoes can sense from far away. At the level of molecules this similarity between what happens when someone eats foods and what happens in cancer growth shows how sensitive mosquito smell is to signs of fast energy use. Cancer cells that use the Warburg effect constantly release acid and other smelly products into the area around them which means people, with cancer naturally send out a strong chemical signal. Because of this the results show that whether it is because of what someone eats or because of cell problems any situation that makes the body release more of these waste products increases the chance that someone will be targeted by insects (12-14).
- **Garlic and Citrus**: Eating plants can actually hide the scent from bugs. When people eat things like garlic the bits of garlic that entering into the body change how skin smells. Specifically, the sulfur in garlic makes it hard for the odor proteins in antennae to work. This stops the mosquito from finding the carbon dioxide that you breathe out. At the time eating citrus fruits every day changes their sweat. The citrus compounds change the pH and the smell of their sweat. Most mosquitoes like a kind of acidic smell but citrus makes their skin smell different. This change, in their skin smell confuses the mosquitoes so they cannot find you. Also, because garlic and citrus are full of antioxidants they help inflammation in their body. When people have inflammation, their skin does not release the specific smells that attract mosquitoes. By changing what you eat you change their skin smell. Make it much harder for mosquitoes to track you down (15-17).
- **Spicy Foods:** Adding capsaicin to their meals starts a series of changes inside the body that go beyond feeling hot. Capsaicin makes the TRPV1 receptor more active which changes how skin cools and what the sweat smells like. This can confuse mosquitoes that look for smells to find people. At the time capsaicin signals, inside cells can mess with the powerhouses of cells that are not healthy turning on a process that kills those bad cells while leaving good cells unharmed. This shows that eating capsaicin can help keep mosquitoes and protect their body from cancer cells. These results mean that careful food choices can use the body routes to reduce both mosquito bites and cancer risk (18-20).

4. Odor chemistry and molecular receptor biology

The structure of these membrane signaling complexes makes it possible to use the drug principles in both insect chemistry and cancer research. For example when mosquito smell receptors join with a partner (Orco) they act like a channel that opens when something is sensed. This behavior is similar to what happens in brain tumors and other cancer types. Also the internal messages that start from these smell receptors like using molecules and changes in calcium are like the signals that cause cancer cells to grow out of control. By using tools designed to find chemicals that stop insects from smelling scientists are now looking for drugs that can stop cancer receptors from working. At the time looking at how plant chemicals stop insects from smelling and also reduce a protein in cancer cells shows a deep connection between how nature defends itself and how cells survive. In the end showing these ways that molecules work proves that the basic rules for sensing chemicals in insects are the same, as the rules that go wrong in human cancer (22-24).

5. Blood group preferences

Research shows that people with Type O blood are twice as likely to get bitten by mosquitoes than people with Type A blood. People release chemical signals from their skin that show which blood type they have and mosquitoes can sense these signals before they land. Studies have found that the mosquito species Aedes albopictus and other disease carriers really prefer hosts with blood group O more than hosts with blood group A. Eighty percent of people release ABO blood group antigens and sugars from their skin giving clear chemical clues that mosquitoes pick up with their sense of smell. Scientists think that the particular carbohydrate patterns in Type O blood might give mosquitoes the nutrients they need for egg growth. Although blood group antigens are the chemical pull other factors like body heat and the bacteria on skin also work together to attract mosquitoes. Because each mosquito species behaves differently the way blood types affect bite risk can change from one place to another and from one group, to another (25-27).

6. Body odour as natural attractants

It has been found that individual body odour can make a difference to how many mosquitoes bite them. Even though most people cannot smell these differences in body odour mosquito that like humans have special receptors that pick up more of the acids that come from the skin. Acids like acid and butyric acid are made when the microbes on our skin break down oils and sweat. Every individual has a set of volatile organic compounds or VOCs that give each person a special chemical fingerprint. That fingerprint tells mosquito where to fly and where to land. Studies that follow people over time show that the amount of these acids a person releases stays mostly the same, which explains why some people keep getting bitten. The. Number of microbes, on the skin that make these acids are strongly shaped by a person’s genes, especially the HLA genes. Mosquito use antenna cells that can sense these acids and they often work together with the smell of carbon dioxide to make the mosquito want to bite (28-30).

7. Pathogen and cancer parallels

The shared inflammatory cascades that link parasite-induced vector attraction and oncogenic progression show a connection between immune activation and the release of volatile organic compounds. When Plasmodium parasites infect a host they trigger a powerful systemic immune response marked by a surge in pro-inflammatory cytokines which directly changes liver and skin lipid metabolism to increase the excretion of specific volatile terpenes and aldehydes that attract foraging vectors. This parasite-driven manipulation of host volatility mirrors the inflammatory environment of malignant tumors, where tumor-secreted cytokines—such as tumor necrosis factor-alpha and interleukin-6—reprogram systemic metabolic pathways speeding up lipolysis and lipid peroxidation to produce distinct volatile biomarkers. At the level both conditions activate the nuclear factor-kappa B signaling pathway, which reduces normal mitochondrial respiration and shifts cellular energy production toward alternative routes that generate volatile byproducts. Mosquitoes use these inflammatory high-volatility states through specialized antennal receptors that evolved to detect signs of physiological stress and weakened host immunity. Consequently, mapping the crosstalk that governs volatile signatures across both malaria infections and tumorigenesis provides a unified framework, for using biomimetic sensor arrays to detect different human disease states through simple non-invasive breath or skin odor analysis (31-35).

Table 1: Factors contributing mosquito attraction to human

Factor	Effect on attraction	Mechanism
Alcohol/Beer	Increases	Alters odor profile, CO_2 output
Bananas	Increases	Elevates lactic acid VOCs
Garlic/Citrus	Decreases	Sulfur & limonene disrupt olfaction
Spicy Foods	Decreases	Capsaicin excreted via skin
Genetics	Variable	Body odor & microbiota
Malaria Infection	Increases	Parasite manipulation of olfactory cues
Plant Volatiles	Variable	Terpenoids & sugar-related compounds

8. Discussion

Mosquitoes spread malaria, dengue and other diseases which makes their interest in humans a major public health problem. Carbon dioxide and body heat are known to attract them. New studies show that diet, smell and the way the bodys molecules work are important. Only female mosquitoes bite humans because they need the proteins in blood to grow their eggs. They follow us using antennas that can sense carbon dioxide. So people who breathe out carbon dioxide, like pregnant women or people who are working out often get bitten more. This review brings together results from NIH, Johns Hopkins, Pfizer and many other studies to give a picture. Mosquitoes spread malaria and other diseases. Their interest in humans is not just by chance. It is because of chemical reactions. Recent research shows that the food people eat and their bodys state change the smells from the skin. Mosquitoes can sense these changes using smell receptors. It is interesting that some of these smells like acid, acetone and aldehydes are also found when someone has cancer. This suggests that there is a link between the way people smell and the way cancer cells work. For years it was not clear what factors are most important in making mosquitoes attracted to people. Some people attract mosquitoes than others. This review tries to find and list those factors that make mosquitoes choose people. Skin. Blood Group Differences In addition to the air people breathe, differences in the way people smell play a role in whether they get bitten by mosquitoes. These different smells are hard for people to notice. Mosquitoes have special sensors that react to more of certain acids on the skin. These acids, like butyric acid come from the way the bacteria on the skin change the oils and sweat from the skin. This mix of smells creates a scent that tells mosquitoes where to go. Studies over time show that the amount of acid a person gives off stays the same which explains why some people are always bitten. The way the bacteria on the skin work is mostly controlled by the persons genes the HLA genes. Also research shows that some types of mosquitoes prefer people with blood group O more than people with blood group A. Most people have chemicals on their skin that are from their blood type. These chemicals help mosquitoes find them. Scientists think that the way the chemicals are arranged in blood type O might give the food or nutrients that mosquitoes need to grow eggs. Blood type chemicals are one of the things that attract mosquitoes but they work with other things like body heat and the bacteria on the skin. This can be different depending on where the mosquitoesre.

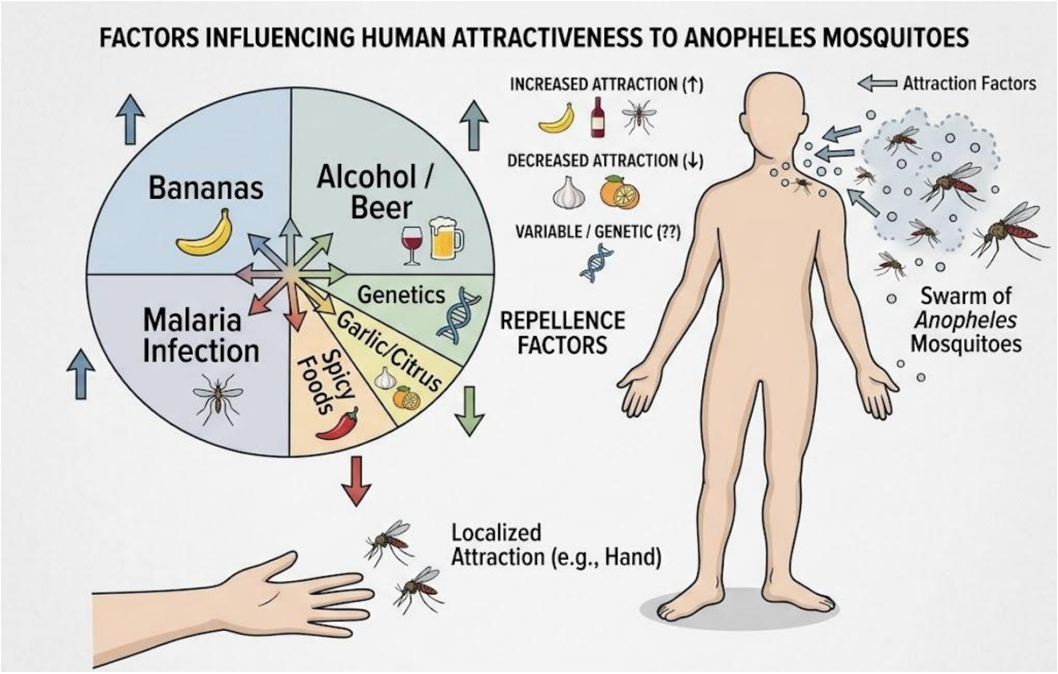

Figure 1: Multiple prameters including diet and VOCs contributing towards attraction of mosquitoes to human

Diet Changes and the Way Cells Work When people change what they eat this adds more to the way people and mosquitoes interact. For example eating food like chili causes changes in the body. This spicy food makes certain receptors in the body work harder which changes how the body controls temperature and the way sweat smells. This changes the smells mosquitoes use to find people. At the time this process also changes the way energy is used in cells. This causes some bad cells to die but leaves cells alone. On the hand eating a lot of alcohol or bananas can make people more attractive to mosquitoes. Both of these foods increase the amount of acid and alcohol smells in sweat. The body changes alcohol quickly. Bananas have a lot of sugar. This makes the body work faster and make the skin warmer. This creates a smell and heat that mosquitoes can sense. At the level of cells this shows how sensitive the mosquitoes are to signs that the body is working hard. Cancer cells that use a way of growing make a lot of lactic acid and other smells. This makes people with cancer more likely to be bitten than people without cancer. Plants and Smell Problems Some plants help reduce the way people smell, which makes it harder for mosquitoes to find them. People who eat garlic or citrus fruits have a smell that stops mosquitoes from finding them. Garlic has smells that stop the way mosquitoes sense other smells, like carbon dioxide. Citrus fruits change the way the skin smells so that it is not as attractive to mosquitoes. These foods also help reduce the way the body reacts to problems and reduce chemicals. This makes the skin smell less attractive, to mosquitoes. The synthesis of olfactory architectures with semiconductor technology allows the creation of real-time non-invasive diagnostic platforms that can continuously monitor a person's body. By combining these electronic sensors with machine learning programs we can decisively sort complex volatile organic compound (VOC) mixtures and clearly separate changes in diet, active vector-borne infections and hidden tissue cancers. This high precision depends on copying the activation patterns seen in insect odor receptors, which react to tiny ratio changes instead of single chemicals. As a result these diagnostic arrays can chart how a patient's skin profile moves from a state to a highly attractive glycolytic pattern that marks early cancer. This cross-field technology changes how preventive medicine is done turning the signs that lure disease carriers into early warning signals for doctors. At the time knowing the exact molecular forces that drive host choice gives us vital clues about how both mosquitoes and the germs they carry evolve. Parasites that change a person's body scent to attract mosquitoes show an advanced survival trick that uses the same smell pathways as cancer metabolism. To fight this we need to make plant-based lures that compete with those chemical signatures and pull mosquitoes away from people. In addition finding the genes that make some people naturally produce repellents gives us a plan for CRISPR gene drives that can change wild mosquito receptors. By mapping the links, between diet, disease and insect smell public health can move from killing pests to carefully managing the environment with science.

9. Conclusion

Human diet, odor chemistry, and molecular receptor biology form a continuum linking mosquito attraction and cancer metabolism. Exploring these intersections may yield dual benefits: improved vector control and novel cancer detection strategies. Future research should focus on mapping shared VOC signatures between mosquito attraction and tumor metabolism,developing odorant receptor-based biosensors for cancer screening, investigating dietary modulation as a preventive tool for both mosquito-borne diseases and cancer.

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