SCIENCE NEWS

Raw Milk May do More Harm Than Good

Not properly stored, it's a source of antibiotic-resistant microbes

Raw or unpasteurized cows' milk from US retail stores can hold a huge amount of antimicrobial-resistant genes if left at room temperature, according to a new study from researchers at the University of California, Davis. The study also found bacteria that harbored antimicrobial-resistant genes can transfer them to other bacteria, potentially spreading resistance if consumed. The study was published in the journal *Microbiome*.

"We don't want to scare people, we want to educate them. If you want to keep drinking raw milk, keep it in your refrigerator to minimize the risk of it developing bacteria with antibiotic-resistant genes," said lead author Jinxin Liu, a postdoctoral researcher in the Department of Food Science and Technology at UC Davis.

Lacking in Probiotics

An estimated 3 per cent of the US population consumes unpasteurized, or raw, milk, which has not been heated to kill pathogens and extend shelf life. Raw milk is often touted to consumers as having an abundant supply of probiotics, or healthy bacteria, compared with pasteurized milk. UC Davis researchers did not find that to be the case.

"Two things surprised us," said Liu. "We didn't find large quantities of beneficial bacteria in the raw milk samples, and if you leave raw milk at room temperature, it creates dramatically more antimicrobial-resistant genes than pasteurized milk."

Bacteria with antimicrobial-resistant genes, if passed to a pathogen, have the potential to become 'superbugs,' so that pharmaceuticals to treat infection or disease no longer work. Each year, almost 3 million people get an antibiotic-resistant infection, and more than 35,000 people die, according to the Centers for Disease Control.

The Longer it Sits, the Worse it Gets

UC Davis researchers analyzed more than 2,000 retail milk samples from five states, including raw milk and milk pasteurized in different ways. The study found raw milk had the highest prevalence of antibiotic-resistant microbes when left at room temperature.

"Our study shows that with any temperature abuse in raw milk, whether intentional or not, it can grow these bacteria with antimicrobial resistance genes," said co-author Michele Jay-Russell, research microbiologist and manager with the UC Davis Western Center for Food Safety. "It's not just going to spoil. It's really high risk if not handled correctly."

Some consumers are intentionally letting raw milk sit outside of the refrigerator at room temperature to ferment, in order to make what's known as clabber. Co-author and Peter J. Shields Chair of Dairy Food Science David Mills said if consumers eat raw milk clabber, they are likely adding a high number of antimicrobial-resistant genes to their gut.

"You could just be flooding your gastrointestinal tract with these genes," said Mills. "We don't live in an antibiotic-free world anymore. These genes are everywhere, and we need to do everything we can to stop that flow into our bodies."

While more work is needed to fully understand whether antibiotic-resistant genes in raw milk translate into health risks for humans, Mills suggests that consumers instead use a starter culture if they want to ferment raw milk, which carries specific strains of bacteria to inoculate the milk.

Other authors include Yuanting Zhu of UC Davis and Danielle Lemay of USDA ARS Western Human Nutrition Research Center.

This study was funded with support from the National Institutes of Health and the Peter J. Shields Endowed Chair in Dairy Food Science.

Source: University of California - Davis

Lifting Weights Makes your Nervous System Stronger, too

The first few weeks of weightlifting strengthen the reticulospinal tract, not muscles

Gym-goers may get frustrated when they don't see results from weightlifting right away, but their efforts are not in vain: the first few weeks of training strengthen the nervous system, not muscles. New research published in *JNeurosci* reveals how.

The brain orchestrates movement via two major neural highways descending to the spinal cord: the corticospinal tract (CST) and reticulospinal tract (RST). The CST is thought to be the dominant pathway, with the RST controlling posture. However, the CST does not change during strength training, so increased strength must stem from the more primitive RST.

Glover and Baker trained monkeys to pull a weighted handle using one arm, with the weight gradually increasing over twelve weeks. Each day, the scientists stimulated the motor cortex and the two motor tracts, measuring the resulting electrical activity in the arm muscles. Over the course of the training regimen, the electrical response from stimulating the cortex and RST increased—a sign of strengthened signaling. After three more months of strength training, stimulating the RST elicited a greater response in the side of the spinal cord connected to the trained

arm. Outputs from the reticulospinal tract become more powerful during weight training and could be the driving force behind increases in strength.

Source: Society for Neuroscience

School Absenteeism has Surprising Consequences for Adults

Even missing school from kindergarten to eighth grade matters

Kids who miss a lot of school from kindergarten to eighth grade may suffer unexpected costs as young adults, a new study finds.

Researchers found that those who were more regularly absent in these early years of school were less likely to vote, reported having greater economic difficulties and had poorer educational outcomes when they were 22 to 23 years old.

The results suggest early school absenteeism should be taken more seriously, said Arya Ansari, lead author of the study and assistant professor of human sciences at The Ohio State University.

"There's this misconception, especially among parents, that it doesn't matter as much if kids miss school early on—that it only becomes important when they get to middle or high school," said Ansari, who is also a researcher at Ohio State's Crane Center for Early Childhood Research and Policy.

"This study shows that those early absences do matter, and in ways that many people don't consider."

The study was published online recently in the *Journal of Youth and Adolescence.*

Ansari and his colleagues used data from the Study of Early Child Care and Youth Development, which is run by the National Institute of Child Health and Human Development.

This study included data on 648 students from 10 cities across the United States who were followed from birth through young adulthood. Researchers had information on the number of days the children were absent from school between kindergarten and eighth grade.

In 2013 and 2014, when the participants were 22 or 23 years old, they reported on a variety of outcomes, from criminal or deviant behaviour to parenthood, political participation and economic hardship.

Results showed that school absenteeism didn't have any relation with criminal, risky or deviant behaviour, Ansari said. But it was linked to political engagement and educational and economic success.

Students who were more frequently absent from school were 4.7 percentage points less likely to have voted in the 2012 election.

They also reported experiencing greater economic hardship (such as difficulty paying bills), were more likely to say they used government assistance such as food stamps, were less likely to have a job and reported poorer educational outcomes, such as a lower high school GPA and a lower likelihood of going to college.

"Absenteeism in those early years of school has pretty far-reaching consequences," Ansari said. "It goes beyond just affecting your education and how well you do in high school."

Ansari said showing up less to school in those early years may set dangerous precedents.

"If you start out being disengaged with school, you may end up being less engaged with society more broadly. You're less likely to vote, less likely to go to college, less likely to be employed," he said.

"We believe disengagement may be one of the key mechanisms linking early school absences to poorer outcomes in early adulthood."

Ansari said the participants in this study were mostly from middle-class families, so results may be different for those from a more disadvantaged background.

"If we're seeing these negative outcomes of absenteeism in this largely middle-class sample, the associations may be even more pronounced among disadvantaged families," he said.

In 2020, parents may be wondering how widespread school closings during the pandemic may be affecting their children. Ansari said this situation is different from what they studied here.

"These really are unprecedented times. All kids are absent. With that said, the differential access to supports and resources will likely result in even greater variability in outcomes when students return to school after the pandemic."

Ansari said he hopes this study will make parents more aware of the importance of school attendance, even for young children.

"What this work suggests is that we should take absenteeism and its consequences more seriously."

Source: Ohio State University

Role Models have Major Influence on Female University Choices

Women exposed to successful and charismatic role models are more likely to follow them in choosing a university major.

An experiment with undergraduates studying introductory economics classes at Southern Methodist University (SMU) in the USA, published in the American economic journal: *Applied Economics*, revealed that female students were hugely more likely to study the subject further having encountered successful female graduates of the same course.

Researchers from Texas A&M University and Lancaster University engaged two role models—chosen with the help of two current female economics majors—to speak with classes of undergraduates studying principles of economics classes about how their choice of major contributed to their success. They measured the uptake of future economics classes among that group when compared with those studying the same course who had no such interaction with the successful women.

Female students' enrolment in further economics classes almost doubled following the role models, encounter, going against general patterns in recent years showing little progress in attracting women to the field.

"Our results show that role model intervention had a significant impact on all outcomes for female students," said report co-author Associate Professor Danila Serra, of Texas A&M University. "Being in a class

that received the role model visits increased the likelihood that a female student would major in economics by almost 100 per cent. The probability of them taking intermediate or any other economics classes also increased by large margins.

"There is strong evidence of the impact of female role models on female students moving into fields of study in which men are traditionally over-represented, and that the encounters served as an inspiration."

Principles of economics classes at SMU are typically gender-balanced, with between 44 and 47 per cent of students female. In contrast, for the next step up, only 26 per cent of students are women, and the gender imbalance worsens by graduation, with less than a quarter of economics degrees awarded to women.

"Due to historical gender imbalances in some subjects, such as economics, it is difficult for young women to come into direct contact with successful women who have majored in these fields and who can inspire them to do the same," said report co-author Dr Catherine Porter of Lancaster University Management School. "Our study suggests that role model intervention could have a significant impact on the treated women's lifetime income streams.

"Our research shows that the long-term goal of moving towards gender parity in the economics profession at all levels could be achieved simply and at a relatively low cost by exposing students enrolled in principles classes to successful and inspiring alumnae."

The researchers' data shows the majority of those women impacted were previously planning to major in lower-earning humanities fields, and the effect did not decrease the number of them majoring in male-dominated, higher-paying fields such as STEM and finance. Those women who swayed towards economics also performed as well, if not better, in exams as the control students, showing the attraction towards the change affected seemingly qualified women who were not previously pursuing economics. Thus, there could be a positive impact on their potential future earnings.

While the effect on female students in the role model classes was marked, there was no effect on the male students in the same groups.

Source: Lancaster University

New Method Measures Temperature within 3D Objects

University of Wisconsin-Madison engineers have made it possible to remotely determine the temperature beneath the surface of certain materials using a new technique they call depth thermography. The method may be useful in applications where traditional temperature probes won't work, like monitoring semiconductor performance or next-generation nuclear reactors.

Many temperature sensors measure thermal radiation, most of which is in the infrared spectrum, coming off the surface of an object. The hotter the object, the more radiation it emits, which is the basis for gadgets like thermal imaging cameras.

Depth thermography, however, goes beyond the surface and works with a certain class of materials that are partially transparent to infrared radiation.

"We can measure the spectrum of thermal radiation emitted from the object and

use a sophisticated algorithm to infer the temperature not just on the surface, but also underneath the surface, tens to hundreds of microns in," says Mikhail Kats, a UW-Madison professor of electrical and computer engineering. "We're able to do that precisely and accurately, at least in some instances."

Kats, his research associate Yuzhe Xiao and colleagues described the technique this spring in the journal *ACS Photonics*.

For the project, the team heated a piece of fused silica, a type of glass, and analyzed it using a spectrometer. They then measured temperature readings from various depths of the sample using computational tools previously developed by Xiao in which he calculated the thermal radiation given off from objects composed of multiple materials. Working backwards, they used the algorithm to determine the temperature gradient that best fit the experimental results.

Kats says this particular effort was a proof of concept. In future work, he hopes to apply the technique to more complicated multilayer materials and hopes to apply machine learning techniques to improve the process. Eventually, Kats wants to use depth thermography to measure semiconductor devices to gain insights into their temperature distributions as they operate.

That's not the only potential application of the technique. This type of 3D temperature profiling could also be used to measure and map clouds of high temperature gases and liquids.

"For example, we anticipate relevance to molten-salt nuclear reactors, where you want to know what's going on in terms of temperature of the salt throughout the volume," says Kats. "You want to do it without sticking in temperature probes that may not survive at 700 degrees Celsius for very long."

He also says the technique could aid in measuring the thermal conductivity and optical properties of materials without the need to attach temperature probes.

"This is a completely remote, non-contact way of measuring the thermal properties of materials in a way that you couldn't do before," Kats says.

Yuzhe Xiao, Chenghao Wan, Alireza Shahsafi and Jad Salman of UW-Madison also contributed to the paper.

Source: University of Wisconsin-Madison

Understanding the Circadian Clocks of Individual Cells

Two new studies suggest cellular rhythms are guided both by heritable and nonheritable components.

The studies led by UT Southwestern scientists outline how individual cells maintain their internal clocks, driven both through heritable and random means. These findings, published online May 1 in PNAS and May 27, 2020 in *eLife*, help explain how organisms' circadian clocks maintain flexibility and could offer insights into aging and cancer.

Scientists have long known that organisms across the spectrum of life have internal clocks—with cycles about as long as a day—that govern behaviours including sleeping, eating, and immune response. However, individual cells also have their own clocks when removed from the organism, with periods that can vary substantially, stretching up to several hours longer or shorter.

How cells maintain these different lengths of internal rhythms has been unknown given that these cells should be the same at the genetic level, explains Joseph S. Takahashi, Ph.D., chair of the department of neuroscience at UT Southwestern Medical Center, a member of UT Southwestern's Peter O'Donnell Jr. Brain Institute, and an investigator with the Howard Hughes Medical Institute.

To investigate this question, Takahashi and his colleagues worked with mouse cells that were genetically altered so that they glowed whenever a prominent circadian clock gene called Per2 turned on. Using this tool, they could see how long the cell's natural oscillations were—ranging from a shorter period of 21.5 hours up to a longer period of nearly 28 hours.

When they isolated cells at the extremes of this range and grew them as clones in petri dishes, the researchers found that these cells maintained their periods. The short and long period cells stayed at their extreme cycle lengths even after many cell divisions over months, suggesting that period length has a heritable component.

When the researchers compared gene expression between the two groups of cells, they found thousands of genes that were either more or less active. Many of these genes appeared to work together in large-scale networks and were associated with stress response signaling pathways and metabolic pathways, underlining the importance of these processes in the circadian cycle. Most of these genes have never been linked with circadian rhythms, says UT Southwestern's Yan Li, Ph.D., the lead author of the studies, suggesting a new pool of candidate genes that might be important in maintaining cellular periodicity.

Looking closer at what caused this differing gene expression between the short- and long-period cells, Takahashi and his colleagues traced it to epigenetic—or "above the genome"—control. Rather than differences in the DNA sequence of genes themselves that caused them to be more or less active, the researchers found that their activity hinged on chemical modifications to the DNA of the genes known as DNA methylation. When they shut down genes that placed or maintained these chemical tags, the cells' circadian cycle length changed.

Although this heritable mechanism accounts for some of the variation between cell period length, it's not responsible for all of it, Takahashi explains. Searching for other sources for cell periodicity, the researchers examined the exact length of circadian cycles in the short- and long-period groups. They found that those with longer periods had the most variability in their cycle lengths. Further tests suggest that this variance is caused by random fluctuations in gene activity. The more of this nonheritable fluctuation that cells exhibited, the longer their cycles were on average. When the researchers dosed cells with a drug that increased this fluctuation in gene activity, it increased their circadian cycles by about 1.5 hours on average.

Together, Takahashi says, these results suggest that the circadian rhythms of cells are controlled both by heritable and nonheritable components. Gaining a better understanding of these mechanisms could provide some insight on natural processes and health problems that are associated

with a decline in circadian clock function, such as aging and cancer. It could also help researchers better understand how organisms maintain flexibility in situations that strain the circadian clock, such as jet lag.

"If every cell in our bodies oscillated in the same way, our bodies would act like one giant clock, inflexible and unable to adapt to a changing environment," Takahashi explains. "Having variability in the cell population makes it more flexible and increases the resilience of an organism."

Source: UT Southwestern Medical Center

New insights into Van Der Waals Materials Found

Layered Van der Waals materials are of high interest for electronic and photonic applications, according to researchers at Penn State and SLAC National Accelerator Laboratory, in California, who provide new insights into the interactions of layered materials with laser and electron beams.

Two-dimensional Van der Waals materials are composed of strongly bonded layers of molecules with weak bonding between the layers.

The researchers used a combination of ultrafast pulses of laser light that excite the atoms in a material lattice of gallium telluride, followed by exposing the lattice to an ultrafast pulse of an electron beam. This shows the lattice vibrations in real time using electron diffraction and could lead to a better understanding of these materials.

"This is a quite unique technique," said Shengxi Huang, *Assistant Professor* of electrical engineering and corresponding author of a paper in *ACS Nano* that describes their work. "The purpose is to understand fully the lattice vibrations, including in-plane and out-of-plane."

One of the interesting observations in their work is the breaking of a law that applies to all material systems. Friedel's Law posits that in the diffraction pattern, the pairs of centrosymmetric Bragg peaks should be symmetric, directly resulting from Fourier transformation. In this case, however, the pairs of Bragg peaks show opposite oscillating patterns. They call this phenomenon the dynamic breaking of Friedel's Law. It is a very rare if not unprecedented observation in the interactions between the beams and these materials.

"Why do we see the breaking of Friedel's Law?" she said. "It is because of the lattice structure of this material. In layered 2D materials, the atoms in each layer typically align very well in the vertical direction. In gallium telluride, the atomic alignment is a little bit off."

When the laser beam shines onto the material, the heating generates the lowest-order longitudinal acoustic phonon mode, which creates a wobbling effect for the lattice. This can affect the way electrons diffract in the lattice, leading to the unique dynamic breaking of Friedel's law.

This technique is also useful for studying phase change materials, which absorb or radiate heat during phase change. Such materials can generate the electrocaloric effect in solid-state refrigerators. This technique will also be interesting to people who study oddly structured crystals and the general 2D materials community.

Source: Penn State University

How does Earth Sustain its Magnetic Field?

How did the chemical makeup of our planet's core shape its geologic history and habitability?

Life as we know it could not exist without earth's magnetic field and its ability to deflect dangerous ionizing particles from the solar wind and more far-flung cosmic rays. It is continuously generated by the motion of liquid iron in earth's outer core, a phenomenon called the geodynamo.

Despite its fundamental importance, many questions remain unanswered about the geodynamo's origin and the energy sources that have sustained it over the millennia.

New work from an international team of researchers, including current and former Carnegie scientists Alexander Goncharov, Nicholas Holtgrewe, Sergey Lobanov, and Irina Chuvashova examines how the presence of lighter elements in the predominately iron core could affect the geodynamo's genesis and sustainability. Their findings are published by Nature Communications.

Our planet accreted from the disk of dust and gas that surrounded our sun in its youth. Eventually, the densest material sank inward in the forming planet, creating the layers that exist today—core, mantle, and crust. Although, the core is predominately iron, seismic data indicates that some lighter elements like oxygen, silicon, sulfur, carbon, and hydrogen, were dissolved into it during the differentiation process.

Over time, the inner core crystallized and has been continuously cooling since then. On its own, could heat flowing out of the core and into the mantle drive the geodynamo? Or does this thermal convection need an extra boost from the buoyancy of light elements, not just heat, moving out of a condensing inner core?

Understanding the specifics of the core's chemical composition can help answer this question.

Silicates are predominant in the mantle, and after oxygen and iron, silicon is the third-most-abundant element in the Earth, so it is a likely option for one of the main lighter elements that could be alloyed with iron in the core. Led by Wen-Pin Hsieh of Academia Sinica and National Taiwan University, the researchers used lab-based mimicry of deep Earth conditions to simulate how the presence of silicon would affect the transmission of heat from the planet's iron core out into the mantle.

"The less thermally conductive the core material is, the lower the threshold needed to generate the geodynamo," Goncharov explained. "With a low enough threshold, the heat flux out of the core could be driven entirely by the thermal convection, with no need for the additional movement of material to make it work."

The team found that a concentration of about 8 weight per cent silicon in their simulated inner core, the geodynamo could have functioned on heat transmission alone for the planet's entire history.

Looking forward, they want to expand their efforts to understand how the presence of oxygen, sulfur, and carbon in the core would influence this convection process.

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Foundation of China, the Foundation for the Advancement of Outstanding Scholarship, the Chinese Academy of Science, the U.S. National Science Foundation, the Army Research Office, the Deep Carbon Observatory, and the Helmholtz Young Investigators Group.

Source: Carnegie Institution for Science

Neurobiology: How Much Oxygen does the Brain Need?

The brain has a high energy demand and reacts very sensitively to oxygen deficiency. Ludwig-Maximilians-Universitaet (LMU) in Munich neurobiologists have now succeeded for the first time in directly correlating oxygen consumption with the activity of certain nerve cells.

The brain requires a disproportionate amount of energy compared to its body mass. This energy is mainly generated by aerobic metabolic processes that consume considerable amounts of oxygen. Therefore, the oxygen concentrations in the brain are an important parameter that influences the function of nerve cells and glial cells. However, how much oxygen is consumed in the brain and how this is related to neuronal activity was so far largely unknown. LMU neurobiologists Hans Straka, Suzan Özugur and Lars Kunz have now succeeded for the first time in directly measuring this in the intact brain and correlating it with nerve cell activity. The scientists report on their results in the journal *BMC Biology*.

In an already established animal model—tadpoles of the clawed frog Xenopus laevis—the scientists used electrochemical sensors to determine the concentration of oxygen in the brain and in one of the brain ventricles. They were able to specifically control the amount of oxygen available to the brain as well as inhibit nerve cell activity with the help of pharmacological substances. Using the example of nerve cells that control eye movements, the scientists succeeded in directly recording the relationship between oxygen consumption and nerve cell activity. "We have found that the brain is anoxic in a normal air-saturated environment, which means that no oxygen can be measured," says Straka. The complete oxygen was therefore immediately used by the cells to synthesize energy-rich substances. If more than twice the atmospheric oxygen concentration was available, the energy metabolism was saturated and oxygen was abundantly present in the brain. "We were also able to show that during normal operation only about 50 per cent of the oxygen is used for nerve cell activity," says Straka. "So the other 50 per cent are required for glial cells and for maintaining the basic metabolic rate of nerve cells. However, nerve cells with increased activity consume more oxygen."

In order to better understand how information is processed in the brain, knowledge of the relationship between oxygen availability and brain activity is essential. The scientists' results provide initial insight into this and are an important basis for further investigations of the brain's energy balance in future experiments and for measuring oxygen consumption for various nerve cell functions. This could also be relevant from a medical point of view, for example to better understand the consequences of oxygen deficiency in the brain or to better interpret the information on brain activity obtained with imaging techniques.

Source: Ludwig-Maximilians-Universität München

What Happens when Food First Touches your Tongue

A new study might explain why humans register some tastes more quickly than others, potentially due to each flavor's molecular size.

The research, published last month in the journal *PLOS Computational Biology*, also provided explanation as to why humans register taste more quickly when food or drink moves over their tongues quickly, as compared to when they are held in their mouth steadily.

The findings indicate that both the speed with which food and drink move in our mouth and the size of the molecules in the food that we consume affect our ability to taste.

"Our tongue has papillae on it that act like a sea of kelp in an ocean," said Kai Zhao, lead author of the paper and an associate professor of otolaryngology at the Ohio State University College of Medicine. "Those papillae—the small bumps that contain taste buds on the human tongue—move and sway as food or drink flow past them."

The human tongue has four kinds of papillae; three of those contain taste buds. (The fourth kind is the most numerous on the tongue, and functions primarily as a way to increase friction.)

For this study, the researchers modelled the way flavors move around the papillae in the tongue, using a range of salty and sweet stimuli. The researchers also built a computer model that simulated previous studies around taste perception.

The model considered the human tongue as a porous surface, with the spaces between the papillae acting like the holes of a sponge. Then the researchers simulated what would happen if they passed a range of salty and sweet flavors over that surface, first quickly, in one intense rush, then slowly.

They found that passing flavors over the tongue quickly caused the flavors to penetrate into the papillae gaps quicker, and that would register flavor more quickly.

And their findings could explain why taste buds were quicker to register a sweet compound with small molecular size as compared with those with large molecular size, such as salty flavors.

"Smaller molecules may diffuse quicker, and we think this could be the reason they move through the papillae gaps more quickly," Zhao said.

This study focused on the early stages of taste—what happens before taste buds have even registered a flavor. Compared with the other senses—sight and sound, for example—taste operates on a sort of time-delay. We hear a sound almost as soon as it is emitted; it takes our taste buds a little longer to register flavor.

"That early response is changed depending on how the molecules of what we are consuming interact with the tongue's surface," Zhao said. "It is a complex process."

Prior to this study, scientists knew that if they dropped a flavored solution onto a person's tongue, the intensity of that solution's taste would increase over time. But they did not know why that happened.

Zhao said scientists assumed the increase in flavor had something to do with papillae, so

for this study, his lab focused on studying the mechanics of how papillae work.

"Our taste buds are important," he said. "They help us figure out what food to eat, how much food to eat, and how to balance the body's nutritional needs with its energy needs."

Taste buds also help humans avoid poisonous substances, can help identify edible and nutritious foods, and contribute to the cravings humans feel for things like ice cream and potato chips.

Zhao said his lab decided to focus on the early stages of taste because it is connected to so many other public health issues, including nutrition and obesity.

Source: Ohio State University

Study Sheds Light on how Cancer Spreads in Blood

Analysis of particles shed by tumors points to new, less invasive way to diagnose malignancies

A new study sheds light on proteins in particles called extracellular vesicles, which are released by tumor cells into the bloodstream and promote the spread of cancer. The findings suggest how a blood test involving these vesicles might be used to diagnose cancer in the future, avoiding the need for invasive surgical biopsies.

The research is a large-scale analysis of what are known as palmitoylated proteins inside extracellular vesicles, according to Dolores Di Vizio, MD, PhD, professor of Surgery, Biomedical Sciences and Pathology and Laboratory Medicine at Cedars-Sinai. Di Vizio is co-corresponding author of the study, published online June 10, 2020 in the *Journal of Extracellular Vesicles*.

Extracellular vesicles have gained significant attention in the last decade because they contain proteins and other biologically important molecules whose information can be transferred from cell to cell. They are known to help cancer metastasize to distant sites in the body, but exactly how this happens is not clear.

To learn more about this process, the research team looked into a process called palmitoylation, in which enzymes transfer lipid molecules onto proteins. Palmitoylation can affect where proteins are located within cells, their activities and their contribution to cancer progression.

The investigators examined two types of extracellular vesicles, small and large, in samples of human prostate cancer cells. Using centrifuges, they separated the extracellular vesicles from the other cell materials and analyzed the levels of palmitoylation and the types of proteins present.

The team found extracellular vesicles derived from the cancer cells contained palmitoylated proteins that are associated with the spread of cancer. Further, when the team chemically suppressed the palmitoylation process, the level of some of these proteins went down in the extracellular vesicles.

"Our results suggest that protein palmitoylation may be involved in the selective packaging of proteins to different extracellular vesicle populations in the body," Di Vizio said. "This finding raises the possibility that by examining these proteins in extracellular vesicles in the bloodstream, we may be able

to detect and characterize cancer in a patient in the future without performing a surgical biopsy."

Di Vizio said the next step in the research is to conduct a study in collaboration with her Cedars-Sinai colleagues and industry partners that will use advanced technologies, including mass spectrometry and flow cytometry, with the goal of identifying clinically significant prostate cancer at diagnosis.

In addition to Di Vizio, Wei Yang, PhD, associate professor of Surgery at Cedars-Sinai, and Andries Zijlstra, PhD, are co-corresponding authors for the study. Zijlstra completed the research while working at Vanderbilt University Medical Center in Nashville. Javier Mariscal, PhD, a post-doctoral scientist in Di Vizio's laboratory, is the study's first author.

Source: Cedars-Sinai Medical Center