



Review Article

REVIEW ON HEALTH IMPACT OF HAZARDOUS AND SAFEST TRADITIONAL COOKWARE WITH AYURVEDIC APPROACH

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ABSTRACT

Human is evolved and nourished by food so food has been given the prime importance since Vedic period, but if our food itself is polluted then how the development of health hazards can be prevented or checked. The contamination of food is a major concern especially for developing countries like India. Today, society are very careful about the selection of food but unfortunately attention has not been given about selection of cookware and the impact of these cooking utensils on health. Number of good looking cookware sets are made by very dangerous material and coated by toxic chemicals to. Most commonly used cookware sets are Aluminum, Plastic and Non-stick cookware. During cooking process these cookware sets releases many hazardous substances like Teflon, BPA, Aluminum etc., which contaminates food and ultimately reaches to the body and linked as a causative factor for many diseases like Cancer, Alzheimer's disease etc. According to FDA materials that are used to make utensils should not allow to migrate into food. Though, traditionally Earthen pots, Cast- iron, glass, bamboo and copper, stone cookware sets were in use. Those were added therapeutic value in the cooked food. Thus, attention must be needed to choose the correct utensils for cooking which should be safe and beneficial for health. In Ayurveda during the description of eight dietary principles, importance of *Vasana* (utensils) is mentioned under the description of *Karana* (processing techniques of food items). Ayurveda believes that container helps in transformation of qualities of food items. Different kinds of utensils had been shown both positive and negative effect on body. Hence, this article makes an attempt to gathered data and compiled to find the health impacts of newly evolved as well as traditional cookware options in society.

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INTRODUCTION

Food has been given the prime importance since Vedic period. Healthy eating with all aspects make a huge impact on today, tomorrow and future in terms of promoting and maintaining good health. Ayurveda considered that *Ahara* (food) *Nidra* (sleep) and *Brahmacarya* (abstinence) are three sub pillars of life and among these foods consider an important factor in the promotion of health and disease prevention. So, detail description regarding wholesome and unwholesome food, properties of each food articles and dietary rules and regulations

have been described in Ayurveda classics. For prevention and promotion of health Ayurveda not only advocates consumption of quality food but also encourages good techniques of food processing and cooking methods for healthy eating. It is well known fact that human is evolved and nourished by consumption of quality food but consequently it is also recognised that consumption of polluted and toxic food eventually can develop various serious health consequences and lifestyle diseases.

Today, society is very careful about the selection of food but unfortunately they are not concerned and aware about the impact of cooking utensils in their health. Though, traditionally unglazed pots or vessels like earthen cookware, iron cookware and brass cookware were commonly using as cooking utensils but today interest shifted towards to various good looking and easy to cook vessels such as non-stick cookware, aluminium and ceramic vessels etc.

The number of new cookware options are available in the market, but most of them not safe or good enough for health because researches indicating that the materials used to make today's most of the cookware sets developing varying degrees of health hazards on the Human body and linked as a causative factor for many diseases like diabetes, Cancer, Alzheimer's diseases. Because during cooking process various metals and other toxic chemicals those are used to make in these utensils are leached into food. Thus, careful selection of utensils for cooking is as important as selection of fresh and wholesome quality food. According to FDA materials that are used to make utensils should not allow to migrate in food. Ayurvedic classics also broadly mentioned that cooking and storage container helps in transformation of qualities of food articles. Hence, this wright-up makes an attempt to review the health impact of today's most used cookware as well as traditional cookware.

Commonly Used Cookware and Their Health Impact

Non-stick Cookware

Non-stick cookware is very popular cookware but it has various disadvantages. Non-stick cookware is coated with various chemical compounds like Perfluorooctanoic Acid (PFOA or C8) and Teflon. Because of the convenient cooking and easy cleaning Teflon coated utensils got popularity. Teflon® is a brand name used for a group of man-made chemicals, the most common of which is polytetrafluoroethylene (PTFE). PTFE has been in commercial use since 1940s. Perfluorooctanoic acid (PFOA), also known as C8, is another man-made chemical. It has been used in the process of making Teflon. PFOA has the potential to impact health and develops health hazards because for long periods of time it can stay in the environment and in the human body.^[1] PTFE is used as an inner coating material in non-stick cookware. This unique polymer coating prevents food from sticking in the pans during the cooking process, easy to wash and it also requires little oil or butter

for cooking food. However, over the past decade, the safety of non-stick cookware has been under investigation. In past the US was making Teflon with PFOA but, today all Teflon products are PFOA-free in US or used in extremely small amounts since 2013 in US. But still some of countries are using PFOA and PFOA is also used in the synthesis of PTFA.

Health hazards develop due to Non-stick cookware

Non-stick cookware utensils are the most popular. But food cooked in non-stick cookware releases chlorofluorocarbons (CFCs) into food during the cooking process and causes various health hazards. According to the Environmental Working Group, Non-stick coatings can "reach 700 degrees Fahrenheit in as little as 3-5 minutes, releasing 15 toxic gases and chemicals, including two carcinogens." The fluoropolymers used in Non-stick utensils at high heat releases various toxic substances and at least one greenhouse gas. At normal cooking temperatures, PTFE-coated cookware releases various gases and chemicals that present mild to severe toxicity. While most of the PFOA on pots was normally burnt off at high temperatures during the manufacturing process, a small amount remained in the final product.^[2] It also reports that even under normal cooking temperatures PFOA was detected in the gas phase released from the cooking utensils.

PFOA has been linked to a number of health conditions. Animal data suggest that pancreatic, testicular, liver, and perhaps breast cancer may be related to PFOA exposure (Lau et al. 2007).^[3] PFOA induces tumours of the testicles, liver, and pancreas in rodents via dietary intake^[4] and also increases mammary tumors.^[5] PFOA linked with infertility and also reduces birth weight in mice and causes neonatal death in rats.^[6] The International Agency for Research on Cancer (IARC) which is part of the World Health Organization has classified PFOA as "possibly carcinogenic to humans" (Group 2B) and stated that it can cause testicular and kidney cancer. But, the long-term effects of PFOA and similar chemicals are largely unknown. Thus, more intense researches are needed to clarify these findings. PFOA also causes lymphoid organ atrophy and decreased *de novo* antibody production in certain strains of mice.^[7]

Non-stick coatings at high temperatures greater than 350°C or 650°F produces very serious health hazards as at this temperature Teflon coatings on non-stick cookware start to break down, releasing toxic chemicals into the air.^[8]

Inhaling these fumes may lead to polymer fume fever, also known as the Teflon flu. Polymer fume fever consists of temporary, flu-like symptoms such as chills, fever, headache and body aches. The onset occurs after 4–10 hours of exposure, and the condition usually resolves within 12–48 hours. A small number of case studies have also reported more serious side effects of exposure to overheated Teflon, including lung damage.^[9]

Aluminum Cookware

An extensive variety of aluminum cookware and utensils especially made locally, uncoated and anodized are used throughout the world. Aluminum cookware are very popular and sold near about double in comparison to other cookware because it is lightweight, heats quickly and evenly and can buy in low cost. Most of these cookware and utensils especially made locally, uncoated and anodized. Various researches identified that during preparation of salty or acid foods untreated aluminium cookware releases large amounts of aluminium into food. Aluminium releases more easily from worn or pitted pots and pans. Aluminum is highly reactive metal that can leach into food. Studies also recorded that if food cooked in aluminium cookware in long time or stored in it than the greater amount of aluminium releases into food. Leafy vegetables, tomatoes and citrus food absorb the most aluminium during cooking from Aluminum cookware.^[10] Good amount of aluminum also found in food which cover by aluminum foil comes in direct contact with foil. The mean exposure from the cookware was estimated 125mg per serving which is more than six times greater than the World Health Organization PTWI of 20mg day for a 70kg adult.^[11]

Studies identified that the metal-food reaction can form aluminum salts that are associated with impaired visual motor coordination and Alzheimer's disease. Aluminium has a tendency to accumulate in tissues and organs thus cause their dysfunction. However, it is more dangerous in patients with chronic kidney disease.^[12] Research studies indicated aluminium work as neurotoxin agent and in high amount have been detected in the brain tissue of Alzheimer patients, Parkinson patients and in dialysis encephalopathy patients.^[13,14] Aluminum toxicity reported more dangerous with kidney failure patients.^[15]

An open-label randomized controlled trial was conducted to address the issue of aluminium accumulation in 42 patients with chronic renal insufficiency. A test group of 30 participants used stainless steel utensils while the control group of 12

participants used aluminium utensils for cooking food for 3 months. The study found a significant increase in transferrin saturation, and significant decrease in serum and daily urine aluminium excretion in the test group compared to those of the control group^[16] Also, aluminum ion can inhibit different metabolism processes by competition reactions with other ions such as iron, magnesium, calcium, phosphorus, fluoride, and others^[17] and has been associated with osteomalacia (aluminium bone disease), dialysis encephalopathy and anaemia.^[18] Locally-made aluminum cookware is also a potential source of lead exposure that has largely been overlooked.

Copper Cookware

Copper conducts heat well, making it easy to control cooking temperatures. Copper leaches into food when heated. Small amount of copper is good for health but its large amount in single dose and in short time can be poisonous. Accordingly, the cooking surfaces are usually lined with tin, nickel or stainless steel. Coated copper cookware can lose its protective layer if damaged or scoured.

Iron Cookware

Iron is recommended for use when high cooking temperatures and popular in the kitchen especially for cooking meat and fried foods. But cookware prepared with cast-iron more popular than iron cookware because Iron it is difficult to make heavy pans and hence would not have the thickness similar to a cast iron pan. So, iron cookware gets heated in such a way that it either can burn the food or may need good amount of oil to cook food fully.

Cast-Iron Cookware

This is heavy duty cookware made of cast-iron. Cast iron is an iron-carbon alloy with a high carbon content (>2%). Instead of Iron cookware, Cast- iron cookware recommended for cooking because it is much thicker and heavier and helps to heat food evenly. It provides higher Iron addition to the food cooked in it. Cast iron cookware gets better with usage and lasts for generations. This material is perfect for grilling and for cooking soups and stews, milk deserts and boiling and storing milk because by accumulating heat, it allows food to slow-cook over a low heat. Unglazed cast iron able to transfer significant amounts of iron into food, but unlike other metals that come off other types of pots and pans, iron is considered a healthy food additive by the U.S. Food and Drug Administration. Cast-iron cookware can work as natural non-stick pots and pans, but this quality of cast iron comes after seasoning (i.e. treating cast iron with oil and

baking it). Seasoning is also used to protect bare cast iron from rust. It can be used on the stovetop or in the oven.

In Asia, particularly China, India, Korea and Japan, there is a long history of cooking with cast iron vessels. Cast iron is a poor heat conductor compared to copper and aluminum, but has a higher heat capacity than copper but a lower heat capacity than stainless steel or aluminum. Moreover, cast iron pans are thicker than similar sized pans of other materials. The combination of these factors results in cast iron pans being capable of storing more heat longer than copper, aluminum, or stainless steel pans. Slow heating over an appropriate sized burner can lead to a more even temperature distribution. Cast iron utensils can retain heat for a long time, and continue cooking food after the heat source has been removed.

Cooking with iron pot is a simple and useful method of dietary iron fortification for the prevention of iron deficiency anemia in developing countries. Iron is essential to produce red blood cells though in big amounts it is poisonous. Iron cookware provides less than 20% of total daily iron intake well within safe levels. An American Dietetic Association said cast-iron cookware can leach significant amounts of dietary iron into food. Though, amount of iron absorption greatly depend on acidity of food, water content of food, cooking time, and age of cookware. Iron deficiency Anemia can be efficiently treated by using cast iron utensil.^[19] But hemochromatosis condition like iron overload, bronze disease should avoid using cast-iron cookware.

Stainless Steel Cookware

Stainless steel utensils are strong, scratch-resistant and long lasting and consider safe for health. They made from iron and other metals like nickel, chromium and molybdenum. These metals can migrate into foods, but until cookware is damaged the amount of metals leach into food is reportedly negligible and no health risks reported with good old stainless steel. Nickel is not poisonous in small quantities. The average adult consumes between 150 to 250 micrograms of nickel per day. The corrosion-resistant nickel found in stainless steel cookware but even cooking with acidic foods such as tomatoes it cannot leach in large amount to the diet. Small doses of chromium, also like iron good for your health.

Anodized Aluminum Cookware

Plain Aluminum cookware is reported several health hazards but Anodized Aluminum cookware is a popular and good alternative to plain

aluminum. It is prepared by placing an aluminum utensil in a chemical solution and then exposed to electric current. Thus a hard, non-reactive surface builds upon this utensil. This process is called anodization. The electrochemical anodizing process "locks in" the aluminium. But, this anodization can break down over a time by repeated use. Thus old Anodized Aluminum pans should be replaced with new one would be safe option for health.

Ceramic, Enamel and Glass Cookware

These are generally safe options easily cleaned and can be heated to fairly high temperatures. But, Lead and cadmium are using for glazing or decorating these sets of cookware which is not good in health concerns as both of these metals are highly toxic substances thus these have to restrict or at least limited in cookware manufacturing. Ceramic cookware has excellent non-stick properties, but the coating can be easily scratched. The glass cookware made by pure liquid sand (silicon dioxide) thus they are good cookware and has no health risks. The only drawback of this cookware is they can fragile easily and had not non-stick properties, but they can easily clean.

Porcelain Cookware

Porcelain is a special type of ceramic, which is made by mixtures of particular white clay (kaolin), with the addition of feldspar and quartz which are then fired at temperatures of between 1300 and 1400°C. Porcelain cooking utensils are extremely hard and have a low level of porosity. They are ideal for the preparation of vegetables, soups and sauces and suitable be used in gas stove and microwave ovens.

Plastic Cookware

Plastic cookware is lightweight and nearly unbreakable. It is used for microwave cooking and storage of food but it is not a good option in comparison to other cookware because of its serious health hazards. If food wrapped or cooked at high temperatures, when microwaving and oily food absorb the chemical plasticiser which is also called Phthalates. Phthalates are chemicals used to make plastic soft, including plastic wrappers. It is known as male reproductive toxicants which reduces sperm count.

Regular use of plastic containers or bottles also has lots of side effects. Even eating hot meals on melamine crockery is harmful to health and increase the risk of kidney stones. Toxin like dioxin released in water in plastic bottles which causes breast cancer. If plastic is exposed to heat these chemicals leach from plastic cookware even faster in good amount. Biphenyl A (BPA) in plastics is an

estrogen-mimicking chemical which lead to lots of health hazards like diabetes, cancer, asthma, infertility, leads to neurological problems, Liver cancer and reduced sperm counts. It affects male reproductive system and reducing sperm quality, and male hormone levels.^[20]

Silicone Cookware

Silicone cookware is popular in recent years because it is colourful, non-stick, stain-resistant, tolerates extremes of temperature and cools quickly. Silicone is a synthetic rubber which contains bonded silicon (a natural element which is very abundant in sand and rock) and oxygen. It is mainly used in bakeware and kitchen utensils. Silicone cookware cannot suitable for direct heat, can melt above 220°C (428°F) so don't use at high temperature, but it is best suited for baking. Silicone rubber does not react with food or beverages, or produce any hazardous fumes so no known health hazards recorded with use of silicone cookware.

Bamboo Cookware

Bamboo is non-reactive and considered to have no harmful effects on food. But its uses are limited for example it cannot used for frying food. It is used for food which is prepared by steam. It has a short lifespan.

Stoneware:

Stoneware has been used for thousands of years. It heats evenly and works as non-stick when seasoned. It is also scratch-resistant and can be heated to very high temperatures without worrying that it cannot leach any hazardous metal at high temperatures.

Earthenware Cookware or Clay Pot

Earthenware cookware is traditional cookware which had always been an intrinsic part of Indian households. However, unfortunately because of the availability of various types of metal utensils earthen pots are rarely used. Earthen pots are cheap and are one of the best medium to cook food. Food prepared in earthen pots is more flavourful and very beneficial for health in comparison to other cookware. Because of the porous nature of a clay pot, moisture and heat retained within the pot itself ensuring a dish that is perfectly cooked and full of flavour. These earthenware pots are available in all shapes and sizes and used for all purposes. Water stored in earthen pot becomes cool flavourful and have a natural sweetness instead of fridge water. Earthen pots are very good for preparation of solid curd and adds that fabulous robust aroma and taste to Boiled milk.

Ayurveda strongly recommends Clay Pot medium for cooking due to its numerous health benefits. The health benefits of cooking in a clay pot are vast because clay pots naturally had various minerals and thus add many important nutrients for example calcium, phosphorous, iron, magnesium and sulphur in food during cooking and storage. Mud contains all the possible vitamins even Vitamin B12. Clay is alkaline thus neutralize the acidity of the food and balance out the pH level of food which makes food digestible. Also, less oil is required for cooking in a clay pot and so, it is experienced that food cooked in clay pots are much lower in fat than food prepared in any other method. Clay pots that have been fired to a point and glazed make them more heat resistant than copper or iron vessel. These pots can be easily used to cook daily meals on a gas burner. Slow cooking in clay pot imparts a delicious earthy flavour of the food and retains all the valuable nutrients in the food hence, food become much healthier and tastier. But without seasoning mud pot can crack easily so new earthen pot should be seasoned thus it can last for a long time. For seasoning new clay pot should be dipped in a vessel full of water for 48 hours and then scrub off the mud inside the clay pot then Let it dry for few hours.

DISCUSSION

Happiness and Suffering with regard to health and diseases depends on Food. Several studies are indicating that, the individual quality of food items solely not responsible for maintenance of health and prevention of diseases but several other things like the cooking methods, presence of any hidden chemicals and toxins in food, and material of cooking utensils and cookware also similarly responsible for preservation of health and development of diseases. Unfortunately, we are exposed to many chemicals even our kitchen is not free from chemicals. Number of attractive cookware are available in market in which most of the easily available and cheap cookware because of their chemical coating, and toxic metals are causing serious health issue in human but due to unawareness today these utensils are getting prominent space in our kitchens by replacing traditional cookware and utensils like earthenware, iron and copper cookware.

Today, most commonly Non-stick and alluminum cookware are in use. The main issues with non-stick and aluminum are that they leach chemicals and heavy metals into food. The toxicity and other health issues of ingested PTFE coatings are very well understood by number of research reports. Also, many studies showed the

possibility of PFOA causing cancer. PFOA induces tumours of the testicles, liver, and pancreas in rodents via dietary intake^[21] and also increases mammary tumors.^[22] So, PFOA has been replaced by other chemicals such as GenX, but health hazards and similar toxicity are also suspected to this alternative.^[23]

Many studies had been shown leaching of aluminium from aluminium cooking utensils. Though rate of aluminium leaching depend on many factors such as pH, temperature, cooking medium, composition of food, duration of contact or cooking and presence of fluoride, sugar, salt and organic acid. Aluminum salts are linked with impaired visual motor coordination and Alzheimer's disease, this risk is more pertinent in patients with impaired renal function.^[24,25]

A study conducted by A.T. Odularu, P.A. Ajibade, P.C. Onianw, Comparative Study of Leaching of Aluminium from Aluminium, Clay, Stainless Steel, and Steel Cooking Pots (2013), analyses was done on the bases of absorption of aluminium by rice boiled in distilled water in a variety of containers, such as old and new aluminium pots, clay receptacles, stainless steel pots, and steel pots, were carried out. Colorimetric analysis of classical methods was used to determine the concentration of aluminium. The control for aluminium was $350 \pm 130 \mu\text{g/g}$. Result of study has identified Aluminium leaching occur in all forms of new and old cooking utensils, and this leaching was found below and within the control concentration range. Result of study identified that old aluminium pots had the highest concentration of leaching ($314 \pm 128 \mu\text{g/g}$.) while new steel pots had the least leaching of aluminium ($132 \pm 68 \mu\text{g/g}$), while alluminium leached in new clay pots had $132 \pm 68 \mu\text{g/g}$, old clay pots had $195 \pm 137 \mu\text{g/g}$, new steel pots had $241.00 \pm 200 \mu\text{g/g}$, old steel utensils had $186.83 \pm 75.18 \mu\text{g/g}$, new stainless steel utensils had $294.83 \pm 163 \mu\text{g/g}$, and old stainless steel utensils had $289.00 \pm 75.155 \mu\text{g/g}$.^[26]

Some safest cookware options are also available in the market that are Cast iron, stainless steel, Anodized Aluminum cookware, copper, earthen pots, Glass, Stone, bamboo, unglazed ceramic and porcelain cookware are considered as safest cookware for Health. Anodization of aluminum cookware protect against leaching of the aluminum into food. A study showed that the amount of aluminium leached from anodized aluminium cooking utensils is equivalent to the amount leached from stainless steel utensils.^[27] Cast iron utensil plays are durable and convenient to handle and useful method of dietary iron

fortification for the prevention of iron deficiency anemia in developing countries.

Because of various health benefits cooking in a clay pot is best option than cooking in a normal utensil. Food prepared in Clay pot makes food more flavourful and nutritious. Cooking in earthen pot is very easy because of its porosity and natural insulation properties; heat and moisture circulate throughout clay pots. So, cooking food in clay pot slowly prevents nutrient loss in food cooked in clay pots comparison to in metal or enamel lined utensils. Result of research study conducted by Qinhui Xing, Xiaohui Xing et al showed that pea pastes cooked in the iron pot contained more iron, total sugar, and starch than the clay pot cooked ones. But the clay pot cooked samples had more colourful, tasty and in overall quality comparison to iron pot cooked pastes.^[28] Result of another study shown better shelf life of food cooked in unglazed earthen pot than food cooked in aluminium pot.^[29]

For preservation and promotion of positive health Ayurveda puts great deal of emphasis upon wholesome diet and for this provided broad dietary guideline about characteristics of food, methods of food processing and cooking techniques, methods of storage of cooked food and advised certain rules and regulation for consumption of food. Thus, the Ayurvedic approach to dietetics is very different from the conventional Western approach. *Caraka Samhita* describes the eight principles of dietary that is called *Ashtaaharvidhi Visheshayatana* they are (1) *Prakriti* (inherent quality of food item), (2) *Karana/Sanskar* (processing techniques of food), (3) *Samyoga* (combinations of food item), (4) *Rashi* (quantity of food), (5) *Desha* (habitat and climate), (6) *Kala* (time factor), (7) *Upayogasamstha* (rules of use), and (8) *Upayokta* (the user).

Among all eight dietary principles, principle of *Karana (Sanskar)* has great importance because Acharya Charak described various techniques of food processing during cooking process which can make changes in the characteristics and property of food and can very efficiently transformed the original properties of particular food item. The transformation of the attributes is effected by *Toya Sannikarsha* i.e., treatment of food item with liquids), *Agni Sannikarsha* i.e., treatment of food item with heat application, *Shaucha* by cleaning for food item, *Manthana* i.e., by churning of food item, *Desha* (place), *Kala* (season) and also *Vasana* or *Bhajana* means selection of the type of vessel for preparation or storage of food. These attributes have potential to transform the inherent quality of food items significantly those were not present previously in those food items and impose new

qualities in food. These changes can be inherent both the good and bad quality in diet or food item.

A famous book on Ayurvedic Dietetics "*Khemakutuhalam*" broadly described different types of vessels for cooking and storing for specific food items along with their therapeutic values. *Khemakutuhalam* also encourages that universally clay vessel is excellent for cooking for all kinds of food stuffs by endowed excellent quality in food. And in the absence of clay vessel prefer to use iron vessel is another good option. This book also indicated the therapeutic values of particular variety of cookware for example food cooked in iron vessel can cure eye diseases and piles, food cooked in bell-metal (*Kansa*) improves intellect, Copper vessel reduces appetite and dyspepsia. Food cooked in gold and silver vessels help to make balance in all three *Doshas* and improve intellect. Specific food items stored in particular storage container also described in "*Khemakutuhalam*" like Ghee has to be stored in wooden or an iron vessel. Meat and meat soup in silver, golden, iron or wooden vessel, leafy vegetables in wooden, stony or iron vessel are used. Boiled milk has to be kept in earthen or wooden vessel. Water, milk dish and buttermilk have to be placed only in earthen container, glass, crystal or gem studded vessels which again indicating that Acharyas was well aware about the fact that different variety of vessel made by different materials can react with particular food items and endorse their quality in it as well.^[30]

CONCLUSION

Society is not aware about health impact of various cookware. Also, a very few researches were conducted to identified the effects of newly developed cookware on health. Therefore, more extensive and systematic research efforts are required to find out the health impact of newly evolved cookware like Non-stick cookware, Aluminum cookware, and toxic effects to PTFE, PFOA, and GenX and other alternatives. Also, it is needed to be identified the safest cookware range with the help of research studies.

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