International Journal of Plant Science and Ecology
Vol. 7, No. 4, 2021, pp. 91-98
http://www.aiscience.org/journal/ijpse
ISSN: 2381-6996 (Print); ISSN: 2381-7003 (Online)

Menacing Populations Determinant of Mice (Rodentia: Muridae) and Guideline for the Interference

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Abstract

Contemporary article deals with mice belonging to the order Rodentia and family Muridae, extraordinarily well-thriving for existing year around in households, foodstuffs setting up and other constructions. Owing to their nourishing and nesting lifestyles, mice result in momentous injury to humanoid diet resources and woody structures, so, chew or bite symbols in these expanses usually designate occurrence of mice. Three utmost communal mice species expected to produce pest burdens for goods holder are house mouse (*Mus musculus* Linnaeus), white-footed mouse (*Peromyscus leucopus* Rafinesque) and deer mouse (*Peromyscus maniculatus* Wagner). Certainly, if mouse faeces otherwise nesting matter are exposed, noises heard within walls or top story (generally at dark), or symbols of food chewed seen on packaging, it is utmost likely that home bears mice. Mice might hold viruses, bacteria, and other parasites and diseases with which they may be infected. Accordingly, cleaning struggles subsequent to an incursion might be carefully tried. Instead of reliant on sprays, the utmost active technique of mouse managing is to avoid mice from acquisition the entrance into business or home. Entirely, doors and windows ought to close very securely, whereas grasses seed and pet food might be retained in fastened vessels, which cannot be gnawed by mice. Property holders have two resistor choices obtainable for elimination of mice from their locations: traps (spring-loaded traps, glue traps and live-catch traps are considered to catch and eradicate rodents or homeowners require to discharge mice outdoor) or poisonous baits (known as rodenticides are framed solely as food-based baits comprising grains or seeds as per an attractant). Traps must be checked every day and deceased mice predisposed of in plastic bags, and gloves ought to be worn while holding mouse bodies to stop any chance of infection. Watchful check-up, elimination practices and prompt resistor are the top selections for durable hindrance to mice activities. On the initial symbol of a mouse invasion, an expert must be so-called to aid in exclude of incursion in advance to a vast density grows.

Keywords

Vertebrate, Rodent, Pest Control, Rat, Mouse

Received: September 14, 2021 / Accepted: November 23, 2021 / Published online: December 6, 2021

1. Introduction

Worldwide, the valuable commodities are always under attack by vertebrate pests equally [1, 2] including rodents (Rodentia: Muridae). Altogether, rodents have the general recognizing structures, for instance, a couple of incisor teeth in upper jaw, have long tail and small legs. Rats and mice both are omnivorous rodents, so look similar, but the biggest difference is their size. Rats are larger and heavier, while mice have smaller slender bodies, and mice also have long slender tails covered with hair compared to rat tails, which bear shorter, thicker and hairless tails [3].

The other at ease differentiating feature is the reduced physique size of house mouse at 3-10 cm lengthy, in

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comparison to a rat's body length of 16-40 cm. However, an adult mouse may be easily mixed up with a fresh rat. A developed mouse may be differentiating from a fresh rat by its longer tail and bigger ears in comparison to its frame size than rat. A fresh rat as well has markedly bigger head and feet in comparison to physique than a mouse. Mice are commonly light grey or brown in shade by means of a lighter shadow on their abdomens [4].

Mice may live in several kinds of habitations, comprising man-made constructions. Mouse invasions may be more communal in family unit than rat incursions. As they are generally more lively at darkness, mice can be problematic to see in day time. Signs of droppings, nesting or chewing, are helpful to recognize a mouse problematic [5]. Moreover, the house mice have the role as significant predator of endangered and endemic birds [6].

In order to reduce these losses, researchers have to bring about the advances in the mice management like the use of some mechanical methods for trapping, killing and pushing of pests, and pesticides (chemicals) as drafted in the present article.

2. Purposes to Manage Mice

Even though maximum of persons think to mice a lesser amount of unpleasant than rats, mice are more communal and result in considerably an extra harm. Mice are abundant breeders, continuously generating 6-10 litters all over the year. The extreme financial damage due to mice is not owing to what amount they consume, however what might be discarded out for the reason that of contamination or destruction. Foodstuff, clothing, equipment, furniture, paperwork and several other domestic things are polluted by way of their urine and droppings, or spoiled by their gnawing [7].

By way of their usual behaviours, mice are able to deteriorate construction configurations by gnawing through aluminium and lead sheeting, and chewing of electrical cabling that can initiate fires by way of shorting-out applications or illumination features. House mice's aggravate done to electrical wiring can as well cause disaster of freezers, dresses dryers and further equipment. As per stated above, mice might eat and chew through everything. They particularly like to grains and can create their tactic through a carton of cereal or crackers without considerably struggle. These likewise consume between 15 and 20 times a day and will create their nest nearby a diet source. Mice infect around 10 times more foodstuff than they feed. Consumption of diet that a mouse has polluted is a sure-fire mode of contracting illnesses from them [8].

All over the biosphere, mice and rats are recognized to spread more than 35 illnesses comprising leptospirosis, plague and tularaemia that can contaminate together to persons and domesticated animals, Mice also can spread other illnesses, best remarkably salmonellosis (bacterial food poisoning) after diet is made filthy by infested rodent droppings. These illnesses can be delivered on through direct interaction, for instance, rat chews; insecure hold and removal of diseased passed on rats; consumption of diet or intake of water polluted with rat saliva, hair, faeces and urine; and inhalation of dirt filthy by the faeces and urine of infested rats [9]. Illnesses can as well be transmitted indirectly via ticks [10-13], fleas and lice [14-20], mites [21] as well as other arthropods [22] and insects [23-26] that live on infected rats.

The three utmost communal mice species probable to make pest burdens for goods holder are house mouse (*Mus musculus* Linnaeus), white-footed mouse (*Peromyscus leucopus* Rafinesque) and deer mouse (*Peromyscus maniculatus* Wagner). The common house mouse is not as hazardous to healthiness as a deer mouse, they can still carry illness, for example, salmonellosis, hantavirus and listeria through their nesting materials, droppings, urine and saliva. These illnesses can be fatal if house owners have a key invasion in homes and the hazard factor of catching any one disease rises. Wild mice can transmit a diversity of illnesses, comprising mouse parvovirus, mouse hepatitis virus and mouse mammary tumour virus. They can likewise be carriers of other human illnesses, for example, streptobacillosis and cryptosporidiosis. Mice are generally parasitized by flukes, tapeworms, lice and fleas [27].

Several species of mouse spread viruses and diseases through their saliva, urine and droppings. Deer mice are the major spreaders of hantavirus, even though other rodents including white-footed mice, rice rats and cotton rats could too be transporters. This virus can be lethal and is set up within saliva, urine and faeces of deer mouse. Hantavirus is transferred to people through airborne bits, and its signs are related to those of common flu. But, persons infected with this virus might look for therapeutic attention instantly upon identification [28].

3. Mice Appearance

Mice naturally develop from 1 to 7 inches (2.54 to 17.78 centimetres) in size and weigh up between 0.5 and 1 ounces (0.014 to 0.028 kg). The African pygmy is the least well-known mouse on the sphere. It is 1.2 - 3.1 inches (3.04 to 7.87 cm) long and can weigh fewer than 0.35 ounce (0.009 kg). These dimensions do not comprise tail measurement. Several mice have tails that are as lengthy as their builds. In the wild these differ in colour from grey and light brown to black (specific coats are in reality agouti coloured), however laboratory mice and domesticated fancy mice are formed in various colours going from white to champagne to black. These have small hair and some, however not entirely, sub-species have a light abdomen [29].

The three sort of mice are actual related in both weight and size. These are normally around 5½ to 7½ inches lengthy, together with the size of their tail that is used for equilibrium. The house mouse is commonly the minutest of these species. One of the greatest apparent differences in these species is colouring. The house mouse is grey-brown by a nearly totally hairless tail, which is as lengthy or lengthier than the physique.

The deer mouse has a tail and feet that are fewer than half the body size, and is greyish-brown to reddish-brown with white-coloured bottoms. The white-footed mouse appearance is nearly matching to deer mouse, excepting for its bigger dimension [30]. The available normative data for the mice are summarized in the Table 1.

Table 1. Normative Values for Mice.

Body shape	Bilaterally symmetric
Life expectancy	1-3 years
Adult weightiness	Male 20-30 g, Female 18-35 g
Diet	4-5 g a day (12 g/ 100 g body weight/ day)
Thirst-quencher	3-5 ml a day (1.5 ml/ 100 g body weight/ day)
Estrous cycle	4-5 day
Pregnancy lasts	19-21 days
Delivery lasts	1-4 hours
Birth weight	1-2 g
Heart rate	310-840 beats per minute
Breathing rate	80-230 breaths per minute
Body temperature	36.5-38°C
Blood volume	7-8%, 1.5-2.5 ml
Urine volume	0.5-1 ml per day
Allergens	Urinary protein, dander

4. Mice Activities, Diet and Habitat

Mice flourish in a diversity of situations; they establish in and nearby to houses and marketable buildings, along with in exposed grounds and farming lands. Mice are tough little creature, most are right good jumpers, may jump about 46 cm in the air and they as well are brilliant swimmers. Even though cooperating with each other, mice create ultrasonic along with regular noises. For each of these three mouse species, everyone is mostly nightly and speedy to escape from dangerous climbers and swimmers. The white-footed mouse and house mouse are upright climbers and adaptive to situations. Certainly, when mice are visible during the day, it is probable a house mouse. House mice live nearby to their nests and seldom mobile further than 100 feet from nest. The deer mouse and white-footed mouse are further expected to venture beyond from their nests [31].

In fact, they alike to consume grains, fruits and seeds. They are omnivorous, which meaning they consume equally plants and meat, and the common house mice will feed just nearly everything it can find. Actually, if foodstuff is limited, mice will even consume to each other. Mice prefer most to consume plants and cereal grains; however, they will forage on nearly everything. These are very usually attracted to dried up and bagged stockpiled foodstuff, together with pet diet. Mice are likely to hoard diet in their burrow or nest, so that it is easily accessible. In their wild and non-domestic locations, mice consume several types of plant leaves, seeds, stems, roots, berries, fruits and insects. The deer mice will likewise devour their personal faeces. After inhabiting spaces nearby to humans, these will consume whatsoever is left lying all over the place and simply accessible to them [32].

Burrow systems constructed by house mice range from 10-835 cm in size, contain 1-7 entry holes and have 1-8 diverse subway sections and 0-5 openings. Lengthier burrows have more sections, more entries and as a minimum one opening. Merely a little nest holes and burrow sections contain stockpiled food when food is abundant. Many burrows have been found with distended holes and grass or large debris placed at burrow entering. This burrow-cleaning activities is planned to eliminate winter gatherings of older rotten mater that might comprise parasites. Female house mice reside in burrow structures occupied by males [33].

The house mouse has a preference to live nearby places wherever persons live, however they too will live in grounds and woodlands, but, they rarely wandering too far from constructions and are the most likely mouse to invade urban regions. As per the climate starts to cool, they search for lodging that is often a house, barn or storage shed. The deer mouse is set up in several diverse habitations comprising woodlands, grasslands, agricultural fields and deserts. But, its utmost common habitations are grasslands, woodlands and bushy areas. White-footed mice are utmost expected to dwell woodland, agricultural locations and suburban. Rodent analyses have revealed that white-footed mice are the maximum plentiful minor rodents in the miscellaneous hardwood plantations and in bushy regions that develop nearby to agrarian fields [34].

5. Mice Reproduction

They have parental care (female provides care) and rely on running to move around. The house mouse raises year-round inside constructions such as houses. Yet, in its wild atmosphere, the breeding time is commonly from nearly April to September. Commencing the oldness of nearby 10 days, females have five couples of mammary glands and nipples, while males have no nipples. After sexually matured, the most remarkable and noticeable dissimilarity is the occurrence of testicles on the males. These are big in comparison to the rest of the body and can be withdrawn into the body [35].

At about 4 to 7 weeks of age, a female mouse will mate with male to have young baby. She will bear her young for 19 to 21

days and provide delivery to a dozen of babies. Females generally have 5-10 litres per year and the size of litter ranges from 3-12 pups, however nearly five or six are normal. Birth generally takes place at nightly with 10-12 pups being born. Widening and hind leg extension are generally symbols of obstructing in birth. Females reach sexual maturity at the age of 5 to 6 weeks and will alive for nearby one year in the wild, and up to 2 years in safe spaces. When young are born, they are not completely developed (altricius). These are born hairless and their eyes open 10-12 days afterward. Young are weaned for 21 days at that time they are about 10-12 g and an adolescence is achieved at 4-6 weeks. Breeding commencement is about 7 weeks and breeding lifetime is 7-9 months [36].

In the typical environment, reproduction of deer mouse does not take place or is severely arisen back for the duration of the winter months. Its litter size varies and may be from 1-11 progeny produced with a usual litter of 4-6. As it might be expecting, reproduction is better in the hotter portions of the states than in the cooler places. Breeding and birthing of white-footed mice happen typically in the spring and late-summer or fall. Adults are prepared to mate at around 38-44 days age, have from 2-4 litres per year, with every litter comprising from 2-9 young. New-born females and males can be notable on close by inspection, such as the anogenital space in male is around twice than that of the female [37].

Remarkably, the female's litter magnitude rises as she contributes birth to more generations; mounts at the fifth or sixth litter and starts to decline as she ages. White-footed mice simply alive for approximately a year in the wild.

6. Signs of an Infestation

Even though the most noticeable symbol of mice is essentially sighting of alive or deceased mice in house, there are sufficient of other marks that can express that a mouse's invasion might be building. These comprise watching of a mouse that is a noticeable symbol of an invasion, particularly known the point that mice are actually nocturnal and secretive. So, the presence of a mouse can show a big population, as other adult mice before now lodge the more caring, concealed dwellings for mice to nest. Furthermost, these animals are habitually marked scurrying alongside walls or running to and from expanses not disturbed normally [38].

Mice faeces are set up in places where mice live, mobile or stay to consume or gather diet. Eliminating of droppings and re-inspecting afterward, is a decent method to decide whether a mouse inhabitant is still full of life inside a construction. Mouse droppings are around 3-8 mm in size almost the dimension of a rice grain and frequently found dispersed accidentally during an invasion. Mouse faeces are granular in form or spindle-shaped and black in shade, and can be found near nesting spaces. Footsteps and pathways left on dusty places can as well be a symbol of a mouse's invasion. As mice are nest constructors, sighting of nests in burrows or wall cavities surely deliver shelter, shows mouse's activity [39].

Mice like to gnaw and crush on any things present in their surroundings. So, the presence of gnawed fragments such as paper, bits of wood and food, pieces of plastic or and gnaw symbols along the edges of wood or other tough materials in repeatedly toured parts, designate the occurrence of mice. If one gets foodstuff packages that look as to be gnawed, a mouse's invasion may be a probability.

Sounds such as mice scurrying from one place to another or from gnawing and scratching within attics or walls are as well symbols of a contamination. Smells from a deceased mouse or urine and faecal deposit are a very disagreeable pointer of a mouse's invasion.

7. Mouse Models of Human Diseases

Inventers from a varied range of biomedical arenas have gravitated to the mouse for the reason that of its close by physiological and genetic resemblances to humans, as well as the easiness with which its genome can be employed and examined. The house mouse *M. musculus*, has been recognized as one of the initial genetically ideal creatures due to its small generation period, relatively big litters, easiness of husbandry and noticeable phenotypic variations. For these causes and the reason that they are mammals, house mice are finely fit to assist as models for human diseases and phenotypes. House mice in the wild comprise of as a minimum three diverse subspecies, and harbour broad phenotypic and genetic discrepancies both inside and amongst these subspecies. Wild mice have been practiced to learn an extensive range of biotic methods, comprising cancer, immunity, adaptive evolution, male sterility and non-Mendelian inheritance [40].

The usage of mice as per model creatures to learn humanoid biology is based on the physiological and genetic resemblances among the species. Nevertheless, humans and mice have developed in and become adjusted to dissimilar atmospheres, so, in spite of their phylogenetic similarity, they have come to be very diverse creatures [41]. So, the usage of mice in biomedical investigation desires to take justification of the developed dissimilarities as well as the resemblances amongst humans and mice.

8. How to Treat for Mice

Worthy hygiene and foodstuff storing rehearses are useful in

decreasing of difficulties with house mice. As seeds are a favourite diet, such sources very nearby to the construction must as well be removed. But, for the reason that mice are capable to reside in such minor nesting spaces and live on small quantities of diet, hygiene only will not generally eradicate a surviving invasion [42].

Nearly all mice difficulties need to the usage of an Integrated Pest Management Program (IPM) tactic. Since white-footed mouse, house mouse and deer mouse to a certain degree have diverse behaviours and habitats. Thus, the primary object of pest management professional (PMP) will be to organize properly identifying the mouse pest and develop an action strategy that is real and effectual for the specific species producing the difficulties. Possibly, the maximum vital issue to study is whether the pest mice are existing outside or inside the construction and wherever they are moving in order to nourish. Knowing about this will aid to plan an operational action strategy. As soon as an action strategy is organized, the client is educated on whatever the PMP will organize and in what way the actions will upset the mouse's density [43].

Dependent upon a particular site, the PMP will work both on non-chemical and chemical approaches. Non-chemical approaches are not active alone, however likewise result in the necessity to usage scarcer chemical means to attain control. Round about active non-chemical control actions comprise as mentioned underneath [44].

Exclusion and sealing off sites bigger than ¼-inch by means of flashing, screen, heavy-duty sealants, door sweeps and other elimination things that permit mice to move in a construction. Keeping of mice beyond the construction is not all the time a simple scheme, but, elimination is the sole, finest long-term means to tackle with mice harms.

It is acclaimed usage of both outside and inside hygiene actions to aid in minimalize existing water and food that invite and support mouse's inhabitants. Likewise, it is commended eliminating of debris, clutter or vegetation that generates hiding spaces that mice can usage as harbourage places.

Several times, the action plan will comprise usage of traps and other mechanical strategies to destroy or eliminate mice.

It is also recommending to usage of chemical foods, for instance, rodent baits that are formed to destroy mice. Though baits are very effective, attention might be applied to make sure that baits are correctly located and the directions on the product's label are firmly tracked. One of the further common practices for bait usage is to place the bait preparation in a tamper proof rodent bait station that defends the bait from accidental coverage to people or non-target animals.

One ultimate object, which must be kept in notice is that do not procrastinate when house owners perceive symbols of a mouse's problematic. The female of house mouse is a very productive animal, hence, if anyone waits too long to imitate control measures, a scarce of them can rapidly develop a great invasion.

8.1. Prevention Tips

Mice come in houses through holes and cracks found in foundations, floors and walls. Homeowners generally do not know holes of mouse till other symbols of invasion appear. Owing to their body form, mice are able to fit through holes far reduced than look possible. Mice might as well come in the house through openings in ceilings or windows, besides through sewerage lines. If drainage pipes are not properly sealed, mice may enter homes through sink or bathtub drains. They are also known to find their way inside via entry holes around plumbing and even gas lines. For preventing of mice from incoming the house, all crevices, cracks, gaps and holes bigger than a pen cap must be closed with a mixing compound or cement. It is not guided that wood should be used to closure these holes, as mice are able to gnawing through those surfaces.

Sanitation might likewise have an influence on mouse invasions and be assured to shower dishes instantly subsequent to usage. Foodstuff should be kept in metal or glass vessels with close-fitting lids. Mice obtain much of their water from foraged foodstuff bits, thus no morsels or crumbs should be leftward on floors or table tops. When a home is previously infected, hindrance approaches ascertain incompetent.

As a result of reducing temperatures, mice invasions are likely to start in reduction. Afterward a group move in a construction and discovers it to be warm and safe, they rarely venture outside once more. Mice multiply rapidly and within a matter of months their densities can go above 200 specimens.

In order to stop mice from incoming to the house, all openings, holes and cracks must be stuck down with cement or metal. All windows and doors might be closed appropriately. Stockpile foodstuffs in metal or glass carafes with fitted tops and be sure to set of all foodstuff unused as soon as probable.

Humans can receive some sounds received by mice and rats; but, abundant of the rodent's audible range is beyond the human range. This hearing range outside of human audible range is called ultrasonic. Ultrasonic or sonic devices have been publicized as repellents for the whole lot from insects to rodents, specially in case of mice. There are several products of these electronic devices that are believed to release either an ultrasonic or sonic wave, to which these pests apparently find annoying. The philosophy of ultrasonic repellents is to generate a sound that is annoying to rodents, however yet at a frequency out of the human hearing range. These sounds are

thought to be disturbing to mice and disappoint them from feeding or settling in affected regions.

Rodents existing within walls do appear outside, while in search of foodstuffs. At this period, homeowners can kill or capture to mice through the usage of traps. Old-fashioned snap traps, as well known as spring loaded-bar mousetraps, are commercially available and widely used. Snap traps are located along passageways where rodents mobile and an attractant, for instance, foodstuff or nesting material can be used. As soon as the spring instrument is triggered, a metallic bar shatters and kills to the rodent.

Glue traps every so often are positioned in related sites as snap traps. Afterwards facing of the trap, mice are arrested by an adhesive surface. Live-catch traps are too commercially existing. These involve that the homeowner must discharge trapped specimens into the normal surroundings and do not warranty that mice will not coming back. In order to be real, the traps might be positioned accurately and alongside expanses frequently visited by the mice. Zapper traps pull to mice into fields before carrying a fatal electric shockwave. But, Zappers are costlier than the other traps and need the usage of batteries.

Homeowners can likewise trap to mice out of walls with foodstuff lure. Even though homeowners might consider baits, but these are not suggested for usage inside family unit. Rodent baits can be lethal to humans and house pets, and could be mistakenly swallowed by small kids if not applied suitably, thus, an expert services are essential.

8.2. Cleaning up After Mice Operation

For the reason that of the diseases danger linked to the mice, cleaning up their nesting or spots they have excreted and urinated is a method, which should not be taken carelessly. Entire surfaces that have come into connection with mice or excrement should be disinfected thoroughly. Mouse's debris and droppings should be picked up carefully and disposed of with well-made non-absorbent gloves, and an appropriate gas mask with working cartridges should be worn. It is also guided that dress worn during cleaning should be immediately thrown away subsequently, and put the filthy paper towels into a plastic bag and throw these in outside refuse, and then should hygienic and clean the whole expanse. Food substances that have been gnawed by mice must be thrown into outside refuse immediately.

Ironically, mouse is as well the species that has rewarded the main tribute to present science, whose genome sequence is very closely correlated to human genome sequence. The genome of mouse is 14 percent lesser than the human's genome, however maximum genes are homologous functionally to their human counterparts and share round 85 percent of their genes with humans, creating them related for learning of human illness. It is used in the finding of antibiotics and the development of vaccines, and can be genetically engineered to work as models of cancer, Alzheimer's disease, diabetes, anxiety and depression, obesity, cystic fibrosis and others [45, 46]. Contact to health career or pest control specialized for service and superfluous solutions.

9. Conclusion

Mice flourish well on plenty of grain to feed and due to diminished populations of predators. Mice habitually live in concealed spaces within houses, as well as attics, storage boxes, roof space and wall insides. Mice are capable to fit through exceedingly small openings in walls, floors and grounds. Afterwards they come in houses, there can be very challenging to acquire rid of them. Mice existing within walls seldom leave their nests for the period of daylight. Their occurrence is made clear by gnawing and scratching noises. Earlier to struggle for killing approaches, homeowners should correctly find that their pests are mice. For control of mice, keep in observance of their behaviour qualities and the top technique to control is preventing their entrance at schools, hospitals, supermarkets and family homes. Catching and eliminating of mice is generally the superlative way for controlling a mouse problematic. It is utmost humanitarian to trap and eradicate or displace mice as soon as probable to lessen their quantities that might be dealt with. Actual rodents control plans are adaptive and integrative, and emphasis on keeping away, prevention and elimination on pests.

Despite of this, mouse is a mammal, a diversity of its hereditary strains are existing, a transgenic mouse can be formed without difficulty, and directed as well as random mutagenesis is probable in genetic and medicinal research. Consequently, mice justify our sympathy and admiration, thus it is crucial that researchers should usage humanitarian procedures to resolve observed complications with them. For explanations stated overhead, investigation on mice and other species is important and must be sustained. This exploration must, however, be planned and understood with suitable gratitude of the developed modifications as well as the resemblances amongst mouse *M. musculus* and human *Homo* sapiens Linnaeus (Primates: Hominidae). All manipulators ought to seek out guidance from a skilled healthcare expert for a identification and solutions to their medical queries in case of vector-borne diseases.

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