

Dropsy (Ascites)

By Duncan Griffiths

Before we can understand what dropsy is we must first understand two natural occurring scientific processes namely, Osmosis and Diffusion.

Osmosis is the movement of a solvent through a semi or permeable membrane from a region of high pressure to a region of low pressure, this process will continue until the two pressures equalise.

Explanation of the above

Imagine two buckets joined at the bottom with a hollow tube and in one side we fill with water, the water will run through the tube until we have equal pressures both sides (equal volumes) then the flow stops similarly if we now put a semi permeable membrane across the centre of the tube in effect blocking the tube, because the membrane is semi permeable and not impermeable and we repeat the exercise the same process will happen albeit at a greatly reduced rate because there is still passage but the membrane offers a form of restriction so when the two bodies of water equalise the flow will stop, if we put an impermeable membrane in and repeat the process the water will stay in one side as it cannot pass This essentially is osmosis natural phenomena that affects all things and can even be seen on fibre glass boats

Diffusion

Diffusion is the movement or migration of a solute in a solvent from an area of high concentration to lower concentration with or without a semi permeable membrane

Explanation

Imagine a still pond with no movement at all no pumps, no flow no nothing, and to one end we add a dye

Over a period of time we will see the dye spreading out without even so much as a stir until the whole pond is evenly coloured at the same concentration this process is called diffusion and is the dye molecules moving naturally from the area of high concentration to the lower concentration till it all becomes equalised.

If we transfer the theory back to our bucket with the semi permeable membrane, if the water has equalised and we now add salt to one side of the bucket but not the other, provided the membrane holes are big enough to take the salt ions it will now begin to move across the membrane into the other side without any energy input until the concentration of salt is the same both sides. There is one draw back with this process tat effects our koi immensely, and that is osmosis and diffusion can and do work hand in hand

In other words as salt moves one way under diffusion the water will move in the opposite direction

If we go back to our bucket example were we added the salt to one side you will notice that as the salt begins to migrate to the lower concentration (the other side) it draws the water in the opposite direction, so the water level on the side the salt was added would rise slightly until saturation was equal then the water would by osmosis begin to go back to equalise the pressures again

Under these processes the membrane is called the Osmotic pressure point

The more astute of you by now will have seen how this process can and does affect our koi

Fresh water teleost fishes have one major problem that's at the heart of the start of all other problems when things go astray

Your inside fluid salinity is 0.9% saline which is equal to 1.5 oz per uk gallon

So in other words if you could wring the water out of yourself out collect the water process all the other elements baring the salt you would have fluid left that's 0.9% in salinity.

It may surprise some to know that both fresh water fish and sea fish have the exact same salinity in their tissue as do we.

In the case of the sea fish this presents a whole lot of problems that the fishes physiology has learned to deal with that are the exact opposite to that of fresh water fish

The problem for freshwater fish is this

While their inside salinity is 0.9% their surrounding environment (water) is a lot lower usually around 0.05%, therefore under the rules of diffusion the koi is constantly losing salts via diffusion, this happens 24/7 and is both involuntary and normal and requires no energy as it's a natural phenomena but the koi has to maintain 0.9% other wise it goes as we do into shock, referred to as osmotic shock

These salts will be lost by process of diffusion mainly across the gut wall and gill the gut has to be able to absorb ions for nutrition which make the gut a semi permeable membrane and therefore what it can gain it can also lose. Same with the gill, the uptake of oxygen for respiration and the release of carbon dioxide and ammonia making that too semi permeable.

As we have already seen where salt moves in one direction the water it's dissolved into will move in the other direction

So the koi is constantly losing essential electrolytes and gaining hydration (water)

As previously mentioned the way the koi replaces valuable salts is by special cells in the gill which work by pumping salts against the natural loss gradient but this takes huge amounts of energy. Incidentally, when I koi is at rest in the winter in shut down mode this energy is still

being used as the osmosis and diffusion rates do not slow in the winter, no matter if the koi is active or in a kind of hibernation the losses and gains are still the same so the energy requirements to counter this remain the same all year round

Obviously neither situation is good for the koi especially as it cannot stop this process happening, but fear not the koi and all freshwater fishes have developed the physiology to counter these detrimental effects

As we have seen the koi is losing salts but gaining fluid if left unchecked by the koi it will bloat with fluid (dropsy) so the koi has developed a couple of mechanisms to deal with this to enable it to live a long a fruitful life

First the koi produces huge, absolutely humungous amounts of urine via the kidney This is how the koi gets rid of unwanted water, further the koi believe it or not never has to drink to hydrate itself as it has no need to, and last but not least the kidney plays a huge role in filtering out essential salts that would other wise be lost in the urine as it is with mammals, it recycles the salt content (puts salt back in the system) thus minimising the salt loss, and in so doing it produces huge amounts of very, very, dilute urine

We as humans are constantly losing water through evaporation and cleansing action of our urinary tract so we have to stop and replace this loss hence we drink and have to drink a set amount a day. If we exercise our water loss increases so we drink more. The koi has no need to drink or dehydrated itself is the influx of water is such that it can only just deal with this so has no need to drink fluids.

By comparison salt water or marine fish the opposite is a reality, the salt water marine fish has the same internal salinity as the fresh water fish but the surrounding water is that of 3.5% salinity so, under the same processes as the fresh water fish, the salt water fish is gaining salt all the time and losing water all the time it's the exact same process but in reverse. The salt water fish every second of every minute of every hour of every day is losing water dehydrating just like ourselves but in by a different mechanical process so just like ourselves it tool has to replace lost fluid

So the salt water fish because internal water is in effect in short supply it has to produce very tiny amounts of urine while cleansing its system because its losing water constantly but it is highly concentrated in salt because it has the opposite and has to get rid of excess salt, similarly the salt water fish must drink water just as we do, to hydrate itself.

The real clever fishes are things like salmon and eels where they constantly go from sea water to fresh water and back again this take a special kind of physiology to be able to adapt to both extremes

So where does this leave us with dropsy?

Well while all the koi's functions are working correctly the kidney etc, all is well. When for what ever the reason the kidney becomes dysfunctional or impaired you can see it may not be able to get shot of the excess fluid and over time, because of this the koi will bloat with water

Its kind of like one person being able to keep a leaky boat a float by bailing it out with a bucket, if we stop bailing or slow down the boat will sink, if we bail it maybe it wont, and that's not a bad analogy as the koi can just about cope with what it has to do to maintain the status quo, with very little in reserve

If the kidney malfunctions through either a mechanical fault renal failure or an infection (temporary or permanent renal shut down or impairment) the fish will begin to blow up until the kidney repairs itself

There is another reason for dropsy, once the koi's skin is breached with an ulcer, by that I mean a breach in the epidermis and dermis, (the barrier) exposing muscle tissue, this will be yet another route in for the water to ingress and the koi may not be able to cope with it's bail out system, which is why we seal a wound. A sealer not only severs to seal our topical in but it in effect put a finger in the dyke, and don't forget that any water entering this way will be laced with the same pathogens that are around the wound and will soon get to the kidney and other major organs

So essentially Dropsy or Ascites as its correct term, in our case, is the retention of naturally occurring fluids usually by the means of the fish cannot displace it

So what can we do about it

Short term we can stop the flow of water by equalising the salinity outside the koi by making the water 0.9% this will in effect stop the salts migrate and therefore stop the ingress of water, so the koi can stop wasting valuable energy bailing itself out or we can alter the gradient of salt so we in effect slow the loss of salts and therefore the ingress of water by taking the salinity to 0.6% this will greatly reduce the flow and so the energy and effort the koi has to use to counteract this.

In the case of bacterial kidney infection we can inject an antibiotic to repair the kidney while we suck the water out with our counter measures

But alas if the kidney is totally screwed and unrecoverable the koi will undoubtedly re fill with water

So the moral of the story is as we have skin that semi permeable don't sit in the bath too long

Duncan

