General hardness (GH) is primarily caused by calcium and magnesium; which are divalent (which means a molecule that has a valence of two) metal ions.

Carbonate hardness (KH) represents the main 'buffering capacity' of the water, i.e. its ability to resist pH changes. Carbonate hardness is due to carbonate/bicarbonate ions (CaC03). KH is the term often used to describe the amount or degree of carbonate hardness.[††] Because carbonate hardness helps the water to resist pH changes, KH and pH is closely inter-related, i.e. if KH is high, the pH will be very stable. If KH is low then the pH will be less stable. Generally, less than 3 degrees KH means the pH will be less stable.

Degrees of Hardness	mg/l $CaC0_3$	Described as:
0- 4 dH	0- 70 ppm	very soft
4 - 8 dH	70 - 140 ppm	soft
8 -12 dH	140 - 210 ppm	medium hard
12-18dH	210 - 320 ppm	fairly hard
18 - 30 dH	320 - 530 ppm	hard

Figure 8 Water Hardness Chart

General hardness (GH) is the more important of the two in biological processes. When a fish or plant is said to prefer "hard" or "soft" water, this is referring to GH. Incorrect GH will affect the transfer of nutrients and waste products through cell membranes and can affect growth.

Decreasing hardness can be done through dilution, such as adding rain water to tap water. Increasing hardness can be done through adding limestone rock or coral gravel. For both cases there are chemical additives available.

Phosphate (P04)

Phosphate deficiencies impact on effective root growth and bud development and can result in poor seed development, fruit quality and size. These symptoms can be a result of other nutrient deficiencies, such as lack of nitrogen and potassium.

Excess phosphorus can also cause a deficiency in other nutrients, in particular iron and zinc and also induce potassium (K) deficiency.

Iron (Fe)

Yellowing leaves on plants means iron (Fe) needs to be added to the system. Iron deficiency is often a caused by high pH; which means pH balance is essential to the system. The way to add iron to a fish tank is by adding chelated iron from a garden supply shop. Others swear that worm tea has enough micronutrients, including iron, and add that to the fish tank. However, there are some issues with worm tea.

Chlorine (Cl)

Chlorine is often added to tap (drinking) water to kill bacteria and ensure that it is safe for human consumption. However, chlorine is not desirable in aquaponics systems for two

[††] KH or the degrees of hardness is often measured differently in different places around the world. Carbonate hardness is temporary and can be changes fairly easily, particularly through boiling of the water, where the carbonates disappear in the steam.