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Review Article

ALKALOIDS IN FOODS

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ABSTRACT

Food is one of the three basic requirements of mankind. It contains moisture, proteins, fat, Fibre, carbohydrate, ash (Vitamins & Minerals), photochemical and etc. Food is the source of nutrients and provides the energy required for all activities eg. growth, repaired of the damaged tissues, reproduction and sustenance. Likewise food also contains alkaloids mainly plant type foods like tea, coffee, cocoa and honey etc. They also act medicine for humans. Alkaloids constitute a very large group of natural nitrogen containing compounds with diverse effects on the human organism. A large variety of plant-produced alkaloids has strong pharmacological effects, and is used as toxins, stimulants, pharmaceuticals or recreational drugs, including caffeine, atropine and cocaine. This paper explains the alkaloids types, three classes of alkaloids and their occurrence, uses and effects when taking higher doses.

Keywords: Alkaloids,Tropane alkaloids, Purine alkaloids, Pyrolizidine alkaloids.

1. ALKALOIDS

Alkaloids are naturally occurring chemical compounds containing basic nitrogen atoms**.** The name derives from the word alkaline and was used to describe any nitrogen - containing base. Alkaloids are produced by a large variety of organisms, including bacteria, fungi, plants, and animals and are part of the group of natural products (also called secondary metabolites). Many alkaloids have been used in medicine over the years and some are still prominent drugs which have physiological effect on animals (Edeoga, H.O and Eriata, D.O, 2001; Sibi G et al., 2014). Many alkaloids can be purified from crude extracts by acid - base extraction. Many alkaloids are toxic to other organisms.

1.1 TYPES OF ALKALOIDS

Alkaloids should be divided into 3 subgroups.

1.1.1 Proper Alkaloids

Proper alkaloids are also known as true alkaloids. These alkaloids are basic. They are nitrogen part of a heterocyclic ring system. These are chemically complex. Some are physiologically active. They have limited distributions in the plant kingdom. Derived biosynthetically from amino acids, especially the cyclic amino acids: Phe, Tyr, Try, His.

1.1.2 Proto Alkaloids

Nitrogen atom is outside the ring system. These are physiologically active.

1.1.3 Pseudo alkaloids

Nitrogen containing compounds (Physiologically active) not derived from amino acids. The purine ring is gradually elaborated by piecing together small components from primary metabolism.

1.2 ALKALOIDS CLASSES

Tropane alkaloids, purine alkaloids, pyrolizidine alkaloids,terpenoidindole alkaloids, benzylisoquinoline alkaloids and other alkaloids: quinolizine, steroidal glycol alkaloids (Mazen A. El-Sakka, 2010).

2. TROPANE ALKALOIDS

2.1 Atropine

It is a tropane alkaloid extracted from deadly nightshade (Atropa belladonna), jimsonweed (Daturastramonium), mandrake (Mandragoraofficinarum) and other plants of

the family Solanaceae. It is a secondary metabolite of these plants and serves as a drug with a wide variety of effects. Solanaceae plants, particularly Daturastramonium L., produce a range of biologically active alkaloids, including tropane alkaloids (AlirezaIranbakhsh et al., 2006).

It is a competitive antagonist for the muscarinic acetylcholine receptor. It is classified as an anti cholinergic drug. Atropine is a core medicine in the World Health Organization's "Essential Drugs List", which is a list of minimum medical needs for a basic health care system. The racemic mixture of (-)-hyoscyamine and (+)-hyoscyamine is called atropine (EFSA Journal, 2013).

2.1.1 Occurrence

Atropine is found in many members of the Solanaceae family (Ratsch C, (2007); BorbalaBoros et al., 2010; GrzegorzGrynkiewicz and Maria Gadzikowska, 2008). The most commonly found sources are Atropa belladonna,Daturainoxia, D. metel, and D. stramonium. Other sources include members of theBrugmansia and Hyoscyamus genera. The Nicotiana genus (including the tobacco plant, N. tabacum) is also found in the Solanaceae family, but these plants do not contain atropine or other tropane alkaloids.

The plant Latua has accumaulates a number of tropanealkaloids, mainly scopolamine and atropine (Silva and Mancinelli, 1959; Bodendorf and Kummer, 1962; Plowman et al., 1971; Orlando Munoz and John F. Casale, 2003). Solanaceae - nightshade or potato family (Griffin and Lin, 2000; EFSA journal, 2008).

Convolvulaceae include the important food plant Ipomoea batatas (sweet potato) (Massal and Barrau, 1956) and furthermore I. aquatica (water spinach) (Austin, 2007), while an additional number of species have been reported as being used as “famine foods” (Freedman, 2012).

2.1.2 Uses

Ophthalmic use

Topical atropine is used as a cycloplegic, to temporarily paralyzethe accommodation reflex, and as a mydriatic, to dilate the pupils.Atropine degrades slowly, typically wearing off in 7 to 14 days, so it is generally used as a therapeutic mydriatic. Atropine induces mydriasis by blocking contraction of the circularpupillary sphincter muscle, which is normally stimulated byacetylcholine release, thereby allowing the radial pupillary dilatormuscle to contract and dilate the pupil.

Resuscitation

Injections of atropine are used in the treatment of bradycardia (anextremely low heart rate), asystole and pulseless electrical activity(PEA) in cardiac arrest. This works because the main action of thevagus nerve of the parasympathetic system on the heart is to decreaseheart rate.Atropine is also useful in treating second-degree heart block.

Secretions and broncho constriction

Atropine action on the parasympathetic nervous system inhibitssalivary, sweat, and mucus glands. This can be useful in treatinghyperhidrosis, and can prevent the death rattle of dying patients.

Treatment for organophosphate poisoning

Atropine is not an actual antidote for organophosphate poisoning.However, by blocking the action of acetylcholine at muscarinicreceptors, atropine also serves as a treatment for poisoning by organophosphate insecticides and nerve gases. Atropine is given as a treatment for SLUDGE (Salivation, Lacrimation, Urination, Diaphoresis, Gastrointestinal motility, Emesis) symptoms caused by organophosphate poisoning.

Optical penalization

In refractive and accommodative amblyopia, when occlusion is notappropriate sometimes atropine is given to induce blur in the good eye.

2.1.3 Adverse effects and Overdose

Adverse reactions to atropine include ventricular fibrillation, supra ventricular or ventricular tachycardia, dizziness, nausea, blurred vision, loss of balance, dilated pupils, photophobia, and, possibly, notably in the elderly, extreme confusion, extreme dissociative hallucinations, and excitation (Bruneton J, 1999; Van Wyk B-E et al., 1997; Van Wyk B-E et al., 2002; Van Wyk B-E, Gericke N, 2000). These latter effects are because atropine is able to cross the blood – brain barrier.

In overdoses, atropine is poisonous. Atropine is sometimes added to other potentially addictive drugs, particularly anti-diarrhea opioid drugs. Although atropine treats bradycardia (slow heart rate) in emergency settings, it can cause paradoxical heart rate slowing when given at very low doses.

2.2 Cocaine

It (benzoyl methyl ecgonine) is a crystalline tropane alkaloid that is obtained from the leaves of the coca plant. The name comes from “coca” in addition to the alkaloid suffix-ine, forming

cocaine. It is a stimulant of the central nervous system and an appetite suppressant.Its possession, cultivation, and distribution are illegal for non-medicinal and non-government sanctioned purposes in virtually all parts of the world. The cocaine alkaloid was first isolated by the German chemist Friedrich Gaedcke in 1855. Gaedcke named the alkaloid "erythroxyline", and published a description in the journal Archiv der Pharmazie.

Forms of cocaine

Cocaine is available in two primary forms. They are cocaine hydrochloride and cocaine alkaloid. Both are extracted from the Central and South American coca plant. Cocaine hydrochloride is an odourless white powder. It is usually snorted (intranasal use) or injected (intravenous [IV] Use). Cocaine alkaloid is not water soluble. It is made into freebase or crack and is smoked, resulting in a faster, more intense high than injecting or snorting(Gold, M.S, 1984; Khalsa, M.E et al., 1992; Diagnostic and Statistical Manual of Mental Disorders, 2000; NIDA Capsules, 1986).

2.2.1 Occurrence

For over a thousand years South American indigenous peopleshave chewed the coca leaf (Erythroxylon coca), a plant that containsvital nutrients as well as numerous alkaloids, including cocaine. There is also evidence that these cultures used a mixtureof coca leaves and saliva as an anesthetic for the performance oftrepanation. Coca leaves are somewhat similar in appearance to Laurusnobilis leaves. Different Erythroxylon species produce leaves varying in size and appearance. They are containing cocaine (De Jong, 1906; Youssefi, Cooks and McLauglin, 1979; Evans, 1981; Rivier, 1981; plowman and Rivier, 1983; Emanuel L. Johnson and Stephen D, 1994; Deborah Pacini and Christine Franquemont, 1985). Chocolates also contain small amounts of cocaine, which are made from cocoa powder.

The TA Cocaine was found in very small amounts in the original Coca-Cola formula, but was not the main concern of the USDA at the time. Caffeine was considered to be the major problem with the drink.

Coca paste

This is off-white, creamy or beige-coloured powder; it is rarely fine, often contains aggregates and is generally damp. Unless the aggregates are crystalline (which is rare) they usually break down under slight pressure. It has a characteristic odour.

"Crack" cocaine

A flaky, hard material obtained by adding ammonia or sodium bicarbonate (bakingsoda) and water to cocaine hydrochloride and heating the resulting precipitatedpowder(Vienna, 2012).

2.2.2 Effects and Health issues:

Health problems resulting from cocaine use can lead to severe mental, physical and social problems.

Acute

Cocaine is a potent central nervous system stimulant. Its effectscan last from 20 minutes to several hours, depending upon the dosageof cocaine taken, purity, and method of administration.The initial signs of stimulation are hyperactivity, restlessness,increased blood pressure, increased heart rate and euphoria (Washton, A.M, 1989). Theeuphoria is sometimes followed by feelings of discomfort anddepression and a craving to experience the drug again. Side effects can include twitching,paranoia, and impotence, which usually increase with frequent usage.

With excessive or prolonged use, the drug can cause itching, tachycardia, hallucinations, and paranoid delusions. Overdoses cause tachyarrhythmias and a marked elevation of blood pressure. Cocaine may lead to death from respiratory failure, stroke, cerebral hemorrhage, or heart - failure. Further mechanisms occur in chronic cocaine use. The "crash" is accompanied with muscle spasms throughout the body, also known as the "jitters", muscle weakness, headaches, dizziness, and suicidal thoughts.

Chronic

Chronic cocaine intake causes brain cells to adapt functionally to strong imbalances of transmitter levels in order to compensate extremes. Thus, receptors disappear from the cell surface or reappear on it, resulting more or less in an "off" or "working mode" respectively, or they change their susceptibility for binding partners (ligands) mechanisms called down/upregulation.

Physical side effects from chronic smoking of cocaine include hemoptysis, bronchospasm, pruritus, fever, diffuse alveolar infiltrates without effusions, pulmonary and systemic eosinophilia, chest pain, lung trauma, sore throat, asthma, hoarse voice, dyspnea (shortness of breath), and an aching, flu - like syndrome.

Tooth enamel and lead to gingivitis: Chronic intranasal usage can degrade the cartilage separating the nostrils (the septum nasi), leading eventually to its complete

disappearance. A common but untrue belief is that the smoking of cocaine chemically breaks down tooth enamel and causes tooth decay.

Addiction

Cocaine dependence (or addiction) is physical and psychologicaldependency on the regular use of cocaine. It can result inphysiological damage, lethargy, psychosis, depression, or apotentially fatal overdose.

3. Purine Alkaloids

Purine alkaloids are secondary metabolites derived from purine nucleotides (Zulak et al., 2006) that have been found in nearly 100 species in 13 orders of plant kingdom (Ashihara and Crozier, 1999a).

3.1 Caffeine

It is a bitter, white crystalline xanthine alkaloid that is a psychoactive stimulant drug. Caffeine was discovered by a German chemist, Friedrich Ferdinand Runge, in 1819. He coined the term kaffein, a chemical compound in coffee, which in English became caffeine. Caffeine is also part of the chemical mixtures and insoluble complexes guaranine found in guarana, mateine found in mate, and theine found in non - herbal tea; all of which contain additional alkaloids such as the cardiac stimulants theophylline and theobromine, and often other chemicals such as polyphenols which can form insoluble complexes with caffeine.

3.1.1 Occurrence

Caffeine is found in many plant species, where it acts as a naturalpesticide, with high caffeine levels being reported in seedlings thatare still developing foliages, but are lacking mechanical protection;caffeine paralyzes and kills certain insects feeding upon the plant.High caffeine levels have also been found in the surrounding soil ofcoffee bean seedlings. Purine nucleotides are synthesized by de novo and salvage pathways (Ashihara and Crozier, 1999a; Stasolla et al., 2003; Zrenner et al., 2006).

Caffeine is found in varying quantities in the beans, leaves, and fruit of some plants, where it acts as a natural pesticide that paralyzes and kills certain insects feeding on the plants. Other sources include yerba mate, guarana berries, and the Yaupon Holly.

The most commonly known sources of caffeine are coffee, cocoa beans, kola nuts and tea leaves. (Barone and Roberts, 1996; Frary et al., 2005).Coffee plants contain two different kinds of alkaloid delivered from nucleotides. One type is purine alkaloids, such as caffeine and theobromine (Hiroshi Ashihara, 2006).

Chocolate derived from cocoa contains a small amount of caffeine. Caffeine is the most common purine alkaloid, but in a few plant species including cacao and unique Chinese tea plants, the main purine alkaloid is theobromine or methyluric acid (Ashihara and Suzuki, 2004).

Tea is another common source of caffeine. Tea leaves contain 2-5% caffeine (Takeda, 1994;Ashihara et al., 1995). Although tea contains more caffeine than coffee, a typical serving contains much less, as tea is normally brewed much weaker. Besides strength of the brew, growing conditions, processing techniques and other variables also affect caffeine content (H. Ashihara et al., 2008).

Caffeine is added to soft drink as flavouring agent (Drewnowski, 2001). Caffeine is also a common ingredient of soft drinks such as cola, originally prepared from kola nuts. Soft drinks typically contain about 10 to 50 milligrams of caffeine per serving. In recent years various manufacturers have begun putting caffeine into shower products such as shampoo and soap, claiming that caffeine can be absorbed through the skin.

3.1.2 Uses

Caffeine is metabolized in the liver into three primary metabolites: paraxanthine (84 %), theobromine (12 %), and theophylline (4 %).

Paraxanthine: Has the effect of increasing lipolysis, leading to elevated glycerol and free fatty acid levels in the blood plasma.

Theobromine: Dilates blood vessels and increases urine volume. Theobromine is also the principal alkaloid in cocoa, and therefore chocolate.

Theophylline: Relaxes smooth muscles of the bronchi, and is used to treat asthma. The therapeutic dose of theophylline, however, is many times greater than the levels attained from caffeine metabolism (Hiroshi Ashihara et al., 1997).

The precise amount of caffeine necessary to produce effects varies from person to person depending on body size and degree of tolerance to caffeine. It takes less than an hour for caffeine to begin affecting the body and a mild dose wears off in three to four hours. Consumption of caffeine does not eliminate the need for sleep (Hicks et al., 1983; Smith, 2002); it only temporarily reduces the sensation of being tired throughout the day. In general, 25 to 50 milligrams of caffeine is sufficient for most people to report increased alertness and arousal as well as subjectively lower levels of fatigue (Rogers et al., 1989; Johnsonet al., 1990, 1991; Nicholson et al., 1990; Zwyghuizen-Doorenbos et al.,1990).

With these effects, caffeine is an ergogenic, increasing a person's capability for mental or physical labour. Caffeine citrate has proven to be of short and long term benefit in treating the breathing disorders of apnea of prematurity and bronchopulmonary dysplasia in premature infants.

3.1.3 Overuse and Effects

In large amounts, and especially over extended periods of time, caffeine can lead to a condition known as caffeinism. Caffeinism usually combines caffeine dependency with a wide range of unpleasant physical and mental conditions including nervousness, irritability, anxiety, tremulousness, and muscle twitching (hyperreflexia), insomnia, headaches, respiratory alkalosis, and heart palpitations (Nawrot, P et al., 2003).

Caffeine intoxication

An acute overdose of caffeine, usually in excess of about 300milligrams, dependent on body weight and level of caffeine tolerance,can result in a state of central nervous system over-stimulation calledcaffeine intoxication or "caffeine jitters". The symptoms of caffeine intoxication are not unlike overdoses of other stimulants. It may include restlessness, nervousness, and excitement, insomnia, flushing of the face, increased urination, gastrointestinal disturbance, muscle twitching, a rambling flow of thought and speech, irritability, irregular or rapid heartbeat, and psychomotor agitation. In cases of extreme overdose, death can result.

Anxiety and sleep disorders

Two infrequently diagnosed caffeine-induced disorders that are recognized by the American Psychological Association (APA) are caffeine-induced sleep disorder and caffeine-induced anxiety disorder, which can result from long-term excessive caffeine intake above 300mg (Lieberman, 1992).

Effects on memory and learning

An array of studies found that caffeine could have nootropic effects, inducing certain changes in memory and learning. However, the tests performed contradict one another and the results have proven inconsistent and inconclusive.

Effects on the heart

Caffeine binds to receptors on the surface of heart muscle cellswhich leads to an increase in the level of cAMP inside the cells (by blocking the enzyme that degrades cAMP), mimicking the effects of epinephrine (which binds to receptors on the cell that activate cAMP production). cAMP acts as a " second messenger ," and activates a large number of protein kinase A.

Effects on children

It is a common myth that caffeine causes stunted growth inchildren. However, scientific studies have contradicted that belief. Children experience the same effects from caffeine as adults. Energy drinks, most of which containing high amounts of caffeine, have been banned in many schools throughout the world.

Caffeine intake during pregnancy

Despite its widespread use and the conventional view that it is asafe substance, a 2008 study suggested that pregnant women whoconsume 200 milligrams or more of caffeine per day have about twicethe miscarriage risk as women who consume none (David Schardt, 2008). However, another2008 study found no correlation between miscarriage and caffeineconsumption.

4. Pyrolizidine alkaloids

Pyrolizidine alkaloids are secondary metabolites that are produced by certain plants. Some plant species produce these substances in order to ward off herbivores (Christina Kastl, 2013). There are more than 660 different pyrolizidine alkaloids which are found in over 6,000 plant species (P. P. Fu et al., 2010) that correspond approximately to 3% of the world's flowering plants and represent a convergent trait in the plant kingdom (Langel, D et al., 2011).

PAs are largely on account of their biological activities, which include acute hepatotoxic (Mattocks, 1986; Schoental**,**R,1968), mutagenic (Hirono et al., 1979), carcinogenic (Hirono et al., 1978), teratogenic (Green and Christie, 1961), anticancer properties (Kovach et al., 1979) and neuroactive properties (Schmeller et al., 1997).

Plants and some insects which sequester PAs from their food plants constitute the only natural source of this group of alkaloids that cause toxic reactions in man and animals (KaleabAsres et al., 2004). The pyrrolizidine alkaloid-containing plants are mostly members of the composite plants (asteraceae), forget-me-not or borage families (boraginaceae) as well as the legume family (fabaceae). Amongst plants containing pyrrolizidine alkaloids native in Germany tansy ragwort, common groundsel and viper's bugloss were found as examples. Chemically speaking, pyrrolizidine alkaloids are esters composed of 1-hydroxymethylpyrrolizidin (necine base) and aliphatic mono or dicarbon acids (necine acids) (BfR FAQ, 2014).

4.1 Occurrence

Some 13 families of the flowering plants contain PAs (Furuya et al, 1987). Only 6 of these families contain hepatotoxic PAs (Anon, 1988) but they represent some 3% of all the species of flowering plants (Culvenor, 1980). The principal families involved are the Asteraceae (Compositae), Boraginaceae (MitraMehrabani et al., 2006) and Leguminaceae (Fabaceae), while the main genera are Senecio (Asteraceae) (Rosa Tundisa, 2007), Crotalaria (Leguminaceae) Heliotroprium, Trichodesma and Symphytum (Boraginaceae).

In Australia Echiumplantagineum (Boraginaceae) is also an important PA-containing species. All three families are well represented in Australia and are causes of poisoning in grazing domestic livestock in all parts of the country (Seawright, 1989). Several Crotalaria spp. cause poisoning in cattle and horses in northern Australia while Heliotropiumspp, Echiumplantaginium and various Senecio spp. are responsible for toxicity in sheep, cattle and horses in southern Australia (Seaman & Walker, 1985). Pigs (Hooper &Scanlan, 1977; Jones et al., 1981) and poultry (Ross & Tucker, 1977) have also become poisoned due to consumption of prepared feeds contaminated with the seeds of Heliotropiumeuropaeum and Crotalaria retusa respectively (Australia New Zealand Food Authority, 2001).

T. farfara species containing PAs belongs to the oldest herbs in traditional medicine, mainly used as a cough suppressant as well as for treating obstructive lung diseases: asthma, bronchitis, and emphysema (ArturAdamczak et al., 2013).

It is possible that PA enter food via plant-based food components. PA has been detected, for example, in herbal teas, cereals, herbs, salads, leafy vegetables and honeys. Cases of elevated contamination in wheat are known to have occurred in Afghanistan. This contamination had been caused by a strong proliferation of plants of the heliotropium genus in wheat fields. In Germany, there have been incidents of contamination of salads with ragwort and groundsel containing pyrrolizidine alkaloids.

As regards PA contamination of honeys, this can, among other plants, be attributed to Echium, Senecio and Borago species. Their pyrrolizidine alkaloid-containing pollen is used by bees to make honey. Raw honeys from certain countries in Central and South America show higher PA contents compared to raw honeys from some European countries. Humans could also ingest PA when such substances get into agricultural farm animals along the food chain, i.e. from contaminated feed into farm animals and from there into animal based foods such as milk, eggs and meat. Based on the current state of knowledge, there are no indications to suggest that such animal-based foods contain PA in concentrations that would pose a health risk to consumers.

4.2 Biological Activity

Antimicrobial Activity

The growth of bacterial species, mostly human pathogens such as E. coli, S. pneumoniae, Bacillus subtilis, B. anthracis and Staphylococcus aureus were inhibited by different pure PAs and PA extracts (El-Shazly et al., 1999; Reina, M., et al., 1995) were tested for their antimicrobial activity against 10 strains of bacteria and 1 strain of fungi by broth microdilution and agar diffusion methods.

Biological Importance

Toxicity of 1,2-unsaturated PAs as hepatotoxic, pulmotoxic, hemolytic, antimitotic, teratogenic, mutagenic and carcinogenic natural products for humans and livestock. The potential PA contamination of food and feeding stuff has attracted recurrent attention. It is evident, that humans should not ingest food or herbal teas that contain PAs. However, some saturated PAs have interesting pharmacological and biological effects, e.g., spasmolytic, antihistaminic, anti-HIV and antiviral activities and as glucosidase inhibitor (Garcia-Moreno et al., 2004; Assem El-Shazly and Michael Wink, 2014).

4.3 Toxicity

The first recorded example of human disease caused by PA-containing plants was that reported in 1920 in South Africa where multiple cases of cirrhosis occurred following consumption of bread made from flour contaminated mainly with the plant Senecioburchellii (Willmot& Robertson, 1920).

PA poisoning of humans can be described by three dose-related levels: acute, sub-acute and chronic (IPCS, 1989; Prakash AR et al., 1999). These levels can be progressive resulting in irreversible chronic toxic effects. On account of the low toxicity of the PAs themselves, acute poisoning has been reported only in very rare cases; it occurs only in infants and neonates due to their higher susceptibility to a PA poisoning. It is characterised by haemorrhagic necrosis, hepatomegaly and ascites; death is caused by liver failure.

Sub-acute levels are characterised by hepatomegaly and recurrent ascites; endothelial proliferation and medial hypertrophy leading to an occlusion of hepatic veins, resulting in the so-

called veno-occlusive disease (VOD) which can be seen as a characteristic histological sign for PA poisoning (Peterson JE, 1983; Huxtable RJ, 1989).

Chronic effects: The typical toxic effects of PA affect the liver and in some case the lungs. Animal experiments have demonstrated that certain pyrrolizidine alkaloids are genotoxic carcinogens (Helmut Wiedenfeld, 2011).

The classical symptoms and signs of human PA toxicosis are abdominal pain and rapidly developing ascites. Lassitude, anorexia, nausea, vomiting, diarrhoea, oedema, emaciation, hepatomegaly, splenomegaly and mild jaundice also occur (Australia New Zealand Food Authority, 2001).

In high dosage, pyrrolizidine alkaloids (PA) can lead to fatal liver failure. The clinical picture of PA poisoning in animals is known as Seneciosis and is usually caused by groundsel found in grazing lands. For example, beef cattle that have eaten Alpine ragwort with hey and silage show increased rates of liver cirrhosis. Cases of intoxication after uptake of high doses of PA have also been reported for humans.

Due to the ingestion of PA, she suffered serious hepatic dysfunction. Similarly, people in Pakistan, India and Afghanistan fall ill after they had eaten wheat contaminated with seeds from Heliotropium or Crotalaria species. In Jamaica, cases of poisoning have occurred through so-called bush teas containing parts of the Crotalaria and ragwort plant.

In order to minimise the potential health risk for people consuming honey as well as herbal and other teas in high quantities and especially for children, pregnant and breastfeeding women, efforts should be made to reduce the PA contents of contaminated foods. This includes sufficient controls of batches of herbal teas and other types of tea prior to marketing. In addition, food business operators should conduct research on the cause of high PA contents. For example, a judicious selection of raw honeys which are used for the manufacture of mixed finished products can contribute to a reduction of PA contents in ready-to-eat honeys. Taken great care when cultivating and harvesting lettuces, vegetables and herbs can also enhance food safety (BfR FAQ, 2014).

CONCLUSION

This alkaloids having medicinal properties but they consume over dose they are leading to diseases like cancer, heart diseases and etc. It is depend upon the types of alkaloids and their level of presence. Alkaloids have six classes. Each class have different alkaloids and they having different characteristic. Mostly some alkaloid has well for health. But some alkaloid has only risk for health. E.g. cocaine has high effective for human health and it can lead breaks down tooth enamel and causes tooth decay. Caffeine consumed high level leading to cancer and miscarriage for pregnant women's. In all countries have Food and Drug Adulteration Act. They have limitations for alkaloid to safe consume food. Alkaloids are naturally occurring chemical compounds in foods. So they are not prevented. They are consuming with limitations.

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