Animal Nutrition

UNIT-IV (NON-RUMINANT NUTRITION)

UG Lecture: 1-3

Laboratory Animal Nutrition,

Nutrient Requirement of Mice, Rat, Rabbit & Guinea Pig

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UG Lecture: 1

Objective……..

- To know the nutrient requirements of lab animal such as rats, mice, guinea pig & rabbit.

Factors determine the nutrient requirements of laboratory animals

- **Category of animals - herbivore, carnivore or omnivore**
- **Species**
- **Sex**
- **Age**
- **Physiological status**

NUTRIENT REQUIREMENT IN DIET FOR RAT AND MICE

Gross composition of rats & mice diet

Nutrient	Rats		Mice
	Maintenance	Growth Gestation Lactation	
ME (Kcal/kg)	3800	3800	3800
Protein %	12	18	18-20
Fibre %	5	5	5
Methionine %	0.2	0.6	0.5
Lysine %	0.1	0.7	0.4
Calcium %	0.5	0.5	1.2
Phosphorus %	0.4	0.4	0.9
Iron mg/kg	35	35	255

- High BMR of these animals causes their high need for energy.
- Protein requirement is higher for mice than rat & quality of protein also should be good.

BIS specifications of compounded feeds for laboratory mice and rats

S. No.	Characteristic	Requirements
1.	Moisture (Max)%	10
2.	Crude protein (Min)%	24
3.	Crude fat (Max)%	5
4.	Crude fibre (Max)%	6
5	Total Ash (Max)	9
6.	Acid insoluble ash (Max)%	1
7.	Calcium (Min)	0.6
8.	Available phosphorus (Min)	0.3

NUTRIENT REQUIREMENT OF GUINEA PIG

- Guinea pig is a herbivorous animal.
- Hind gut fermenter and practices coprophagy.
- The following is the nutrient requirement for a guinea pig diet;

Nutrients	Requirements
ME Kcal/kg	2800
Protein (%)	18
Fibre (%)	15
Calcium (%)	0.8-1
Phosphorus (%)	0.4-0.7
Zinc (mg/kg)	20
Iron (mg/kg)	50
Note: 1 gram of vitamin C per kilogram of ration has to be supplemented as Vitamin C is dietary essential in guinea pig	

NUTRIENT REQUIREMENT OF RABBIT

- Rabbit is a monogastric herbivore, hindgut fermenter, practicing coprophagy.
- Energy requirement is expressed as DE or ME.
- Protein is expressed as crude protein.
- Rabbits are able to tolerate upto 15% crude fibre.

Nutrient requirements for different categories of rabbit

Components of feed	Unit	Growing rabbits (4-12 weeks)	Lactating doe+ young under mother	Pregnant doe, not lactating	Resting adults (males)	Mixed breeding does plus fatteners
Crude proteins	%	16	18	16	13	17
Metabolizable energy	kcal/kg	2400	2500	2400	2120	2410
Digestible energy	kcal/kg	2500	2600	2500	2200	2500
Fats	%	3	3	3	3	3
Crude fibre	%	14	12	14	15-16	14
Indigestible crude fibre	%	12	10	12	13	12

Components of feed	Unit	Growing rabbits (4-12 weeks)	Lactating doe+ young under mother	Pregnant doe, not lactating	Resting adults (males)	Mixed breeding does plus fatteners
Amino acids						
Methionine + cystine	%	0.60	0.60	-	-	0.60
Lysine	%	0.65	0.75	-	-	0.70
Arginine	%	0.90	0.80	-	-	0.90
Threonine	%	0.55	0.70	-	-	0.60
Tryptophane	%	0.18	0.22	-	-	0.20
Histidine	%	0.35	0.43	-	-	0.40
Isoleucine	%	0.60	0.70	-	-	0.65
Phenylalanine + tyrosine	%	1.20	1.40	-	-	1.25
Valine	%	0.70	0.85	-	-	0.80
Leucine	%	1.05	1.25	-	-	1.20

Components of feed	Unit	Growing rabbits (4-12 weeks)	Lactating doe+ young under mother	Pregnant doe, not lactating	Resting adults (males)	Mixed breeding does plus fatteners
Minerals						
Calcium	%	0.40	1.10	0.80	0.40	1.10
Phosphorus	%	0.30	0.80	0.50	0.30	0.80
Potassium	%	0.60	0.90	0.90	-	0.90
Sodium	%	0.30	0.30	0.30	-	0.30
Chlorine	%	0.30	0.30	0.30	-	0.30
Magnesium	%	0.03	0.04	0.04	-	0.04
Sulphur	%	0.04	-	-	-	0.04
Cobalt	ppm	0.1	0.1	-	-	0.1
Copper	ppm	5	5	-	-	5
Zinc	ppm	50	70	70	-	70
Iron	ppm	50	100	50	50	100
Manganese	ppm	8.5	2.5	2.5	2.5	8.5
Iodine	ppm	0.2	0.2	0.2	0.2	0.2
Fluorine	ppm	0.5	-	-	-	0.5

Components of feed	Unit	Growing rabbits (4-12 weeks)	Lactating doe+ young under mother	Pregnant doe, not lactating	Resting adults (males)	Mixed breeding does plus fatteners
Vitamins						
Vitamin A	UI/kg	6000	12000	12000	6000	10000
Vitamin D	UI/kg	900	900	900	900	900
Vitamin E	ppm	50	50	50	50	50
Vitamin K	ppm	0	2	2	0	2
Vitamin C	ppm	0	0	0	0	0
Vitamin B_1	ppm	2	-	0	0	2
Vitamin B_2	ppm	6	-	0	0	4
Vitamin B_6	ppm	2	-	0	0	2
Vitamin B_{12}	ppm	0.01	0	0	0	0.01
Folic acid	ppm	5	-	0	0	5
Pantothenic acid	ppm	20	-	0	0	20
Niacin	ppm	50	-	-	-	50
Biotin	ppm	0.2	-	-	-	0.2

Advantages of laboratory animal for experiment?

- Easy to handle
- Cost effective
- Wide variation of species
- Suitable for biomedical research
- Fast absorption of nutrients and getting result
- Suitable for purified diet experiment
- Wide genetic variation among species
- Statistically suitable with numbers availability
- Repetition of experiment is easy
- Slaughter study is easy for organ examination

Discussions……..

Questions, if any……??

THANKS

UG Lecture: 2

Objectives……..

- Describes about the diet formulation, preparation and feeding practices of lab animal such as rats, mice & guinea pig.
- Learn to gain information about the diet formulation, preparation and feeding practices of rabbits.

INTRODUCTION TO DIET PREPARATION FOR LAB ANIMALS

- **Feeding of rat, mice & guinea pig by using of three types of diets such as;**
- ***Natural diets:*** **This diet is prepared from natural ingredients & comprises of a blend of cereals, legumes, oilcakes, fruits, vegetables, roughages etc.**
- ***Semi synthetic diets:*** **This diet is prepared from a combination of natural & purified ingredients (starch, sugar, casein, fat, vitamins & minerals).**
- ***Synthetic diets or purified diet:*** **It is prepared from a combination of purified protein, amino acids, carbohydrates, fats, minerals & vitamins.**

RAT & MICE FEEDING

- Rats & and mice are omnivores & eat plant material and meat products.
- They possess continually growing incisors which wear down.
- Clean water must be readily available at all times.
- Pellet feed are preferred (3-4 mm in diameter & 8 mm length).
- Diets containing seeds & nuts are not recommended because it contain much fat & oils with inadequate protein levels.

Sample diet for feeding rat & mice

Ingredient	Quantity (g)
Ground wheat	230
Wheat middling	100
Ground corn	245
Corn gluten meal	30
Soyabean oil	25
Dehydrated alfalfa meal	40
Soyabean meal	120
Fish meal	100
Dried molasses	35
DCP	12.5
Ground limestone	5
Iodized salt	7
Salt	5
Non fat dry milk solids	50

Feed intake by rat and mice

- Adult mice will eat 4-5 grams per day.
- Adult rats will eat 12-15 grams per day.

Type of feed

- Pellet feed preferred due to gnawing
- Pellet size - 3-4 mm in diameter & no longer than 8 mm.

GUINEA PIG FEEDING

- Guinea pigs are herbivores, require plenty of grass hay & greens and limited concentrate.
- Have continuously growing incisors & molars which wear down with the normal action of eating.
- Guinea pigs produce nutrient rich caecotropes which they eat directly from the anal area.

Feed Consumption

- Growing guinea pigs: 20 -30 g
- Adult guinea pigs: 30 – 50 g
- Pregnant and lactating: 40 – 60 g

Guinea pig feed

- Guinea pigs ration contains 18-20% protein, 15-16% fibre & about 1 gram of vitamin C per kilogram of ration.
- However, during storage of feed about half of the vitamin C content is degraded & lost within 6 weeks of manufacture .
- Dark leafy greens are important to guinea pigs due to their requirement for an external source of vitamin C.
- Minimum daily requirement for vitamin C in the guinea pig is 10-30 mg/day.
- Guinea pigs can easily get this amount by feeding of 1/2 to 1 cup of fresh leafy greens daily.
- Supplementation of vitamin C in water is not very effective due the rapid breakdown, when exposed to light & heat.

Water for Guinea pig

- To be kept free from contamination by providing in water bottles.
- Guinea pigs contaminate and clog their water bottles by chewing on the end of the sipper tube & backwashing of food particles into it.
- Guinea pigs do not tolerate changes in the presentation, taste, odor, texture or form of their food & water.
- Any changes in the food should be made gradually.

Recommended nutrient allowances for growing guinea pigs

Nutrient content		Sample Diet	
ME Kcal/kg	2800	Ingredient	g/Kg
Protein (%)	18	Alfalfa meal	350
Fibre (%)	15	Ground wheat	236
Calcium (%)	0.8-1	Ground oats	252.5
Phosphorus (%)	0.4-0.7	Soyabean meal	120
Zinc (mg/kg)	20	Ground limestone	10
Iron (mg/kg)	50	Iodized salt	7.5
		DCP	5
		Soybean oil	15
		Minerals & vitamins	4

FEEDING OF RABBITS

- **Rabbits are herbivores, requires plenty of roughage & limited concentrates.**
- **They have continuously growing incisors & molars which wear down with the normal action of eating.**
- **As in guinea pigs they produce nutrient rich caecotropes which they eat directly from the anus area.**

Colon uniqueness of Rabbit

- **Proximal colon has dual function, if the contents of the caecum enter the colon in the early morning, they undergo few chemical changes & purely become pellets coated with mucus and these pellets gather into clusters, are known as soft or night pellets or *Caecotrophes.***
- **At other times of the day, the solid part of the food containing fibres over 0.3 mm long, forms hard pellets & is excreted out.**
- **Hard pellets are expelled directly, but the soft pellets are recovered from the anus immediately.**
- **To do this, the rabbit twists itself around, sucks on the soft faeces and then swallows them without chewing.**

- **By the end of morning, there are large numbers of soft pellets inside the stomach which comprises almost ¾ of the total contents & follow the same digestion pattern as normal feed.**
- **Some parts of the feed may be recycled up to 4 times and this process of recycling faeces in order to complete digestion of feed is known as *caecotrophy*.**
- **Half of the pellets consist of imperfectly broken-down food & gastric secretions whereas, other half consists of bacteria (contain a large amount of high-value proteins) & water soluble vitamins.**

Feeding of rabbits through their stages of development

- Rabbits need to be fed differently at different stages of their growth to ensure healthy development, digestion and weight gain.
- Avoid any sudden changes in diet.
- New foods should always be introduced gradually.
- Fresh clean water should be available all the times.
- Water bottles are recommended for waterer.

Feeding of kits

- Baby rabbit or kit, feeds solely on its mother's milk for first 3 weeks.
- During the first few days, the milk contains high levels of antibodies that help to protect the kit from disease.
- After 3 weeks, the kit will begin nibbling on feed offered to its mother.
- By 7 weeks of age, kits can be fed feed similar to that of an adult.
- Weaning is practiced by 8 weeks of age.

Feeding of Juveniles

- Between weaning & 7 months of age, young rabbit can have an unlimited amount of feed both roughage & concentrate.

Feeding of young adult

- Young adult rabbits from age 7 months to 1 year should be introduced to grass/ hays, and it should be available all day.
- At this stage they will require little concentrate.

Feeding of Mature adult

- Mature adult rabbits should be fed on hay/grass.
- Concentrate can be reduced in maintenance rabbits.

Feeding of pregnant & lactating does

- Hay / grass is fed adlibitum & concentrate can be fed upto 200 g /doe /day.

Feed intake by Rabbits

- Growing rabbits (After weaning) = 100g
- Resting Does = 150g
- Does in Gestation = 250g
- Nursing Does (until litter is 3 weeks of age) = 250g
- Does with litter of 7 or 8 (3 to 8 weeks) = 1000g

FEEDSTUFFS USED FOR RABBIT

Dry matter intake (DMI)

- For maintenance DMI is 3.8 to 4% of BW per day & it increases based on growth & production.

Feedstuffs commonly used for rabbits

- Green roughages: Grasses, weeds & leafy vegetable.
- Root crops: Carrots, sweet potatoes, turnips & beets.
- Cereal grains & by-product: Oats, wheat, barley, corn, rice & bran.
- Hays: Leguminous or non leguminous.
- Protein supplements: Oil cake or pulses.
- Common salt.

Complete feed for rabbits

- **Rabbits can be fed complete feeds in a pelleted form given below is an example of ingredient composition of complete feed.**

DCP %	TDN %	Ingredients	Quantity (grams)
16	68	Cow pea hay	30
		Maize	28
		DORB	25
		GNC	15
		Min. mix.	1.5
		Salt	0.5

Chewing items

- Feed that requires little chewing, produces uneven tooth wear, causing enamel to grow on the sides of the teeth.
- These spikes can cause severe oral pain and excessive salivation.
- Also cause reluctance to chew, inability to close the mouth & reduced food intake.
- In addition to roughages, rabbits can be provided with chew sticks made of wood or any safe material.
- Feed efficiency for rabbits is 2.5 : 1 .

Discussions……..

Questions, if any……??

THANKS

UG Lecture: 3

Objective……..

- **Learn to describes the significance of various nutrients in lab animals.**

SIGNIFICANCE OF CARBOHYDRATES IN LAB ANIMALS

- Energy source
- Building block for other nutrients
- Dietary excess stored as fat
- Starch and some oligosaccharides digested in the SI of lab animals by enzymes of salivary glands, pancreas & intestinal brush border.
- Cellulose, hemicelluloses, pectin and some oligosaccharides are partly digested by the micro flora of the large intestine.
- Fiber digestibility varies considerably & depends on the nature of the fiber & animal species.

SIGNIFICANCE OF PROTEIN IN LAB ANIMALS

- **Most expensive ingredient in ration is proteins.**
- **Broken down in the stomach during digestion by enzymes, proteases into smaller polypeptides to provide amino acids for the body, including the essential amino acids that cannot be biosynthesized by the body itself.**
- **Dietary protein is a source of Essential Amino Acids (number, type and level of amino acids required varies with animal species).**
- **When fed in excess, converted to energy, fat.**

SIGNIFICANCE OF LIPID IN LAB ANIMALS

- Fats are important source of stored energy in plants & animals, characterised by their high energy value (1 gram fat = 9.3 Kcal or 39.1 KJ).
- Components of biological membrane.
- Carrier for fat soluble vitamins – A, D, E and K.
- Useful as electron carrier & useful source of metabolic water.
- Exert insulating effect to the body thus protecting it from excessive heat or cold.
- The mesenteric fat acts as a padding to protect the internal organs.
- Sources of essential fatty acids – linolenic, linoleic and arachidonic acids.
- Acetic acid and bile acids form important building blocks of biologically active materials like cholesterol, sex hormones and steroids.

SIGNIFICANCE OF MAJOR MINERALS IN LAB ANIMALS

CALCIUM AND PHOSPHORUS

- Structural component of body (skeleton and teeth).
- 99% of the calcium in the body is present in bones and teeth.
- Ca is essential for various enzyme systems necessary for the transmission of nerve impulses & contractile properties of muscle.
- It is also concerned in the coagulation of blood.
- Phosphorus occurs in close association with calcium in bone.
- It occurs in phosphoproteins, nucleic acids and phospholipids.
- It plays a vital role in energy metabolism in the formation of sugar-phosphates and adenosine di- and triphosphates.

- **Shell grit, limestone, are very good calcium supplements**
- **Fish meal, bone meal and legumes, are good sources of calcium and phosphorus.**
- **Calcium and phosphorus are deficient cause rickets (misshapen bones, enlargement of the joints, lameness and stiffness).**
- **In adults, Ca & P deficiency produces osteomalacia (calcium in the bone is withdrawn and not replaced & bones become weak & easily broken).**
- **Low dietary intakes of phosphorus, associated with poor fertility.**
- **Phosphorus deficiency can also cause pica or depraved appetite.**
- **Ca : P ratio considered most is generally within the range 1:1 to 2:1.**

SODIUM, POTASSIUM & CHLORINE

- Sodium of the body is present in the soft tissues and body fluids.
- Concerned for acid-base balance & osmotic regulation of the body fluids.
- Na is chief cation of blood plasma and other extracellular fluids of the body.
- The sodium concentration within the cells is relatively low.
- Na plays role in the transmission of nerve impulses & absorption of sugars and amino acids from the digestive tract.
- Potassium along with sodium, chlorine and bicarbonate ions, in osmotic regulation of body fluids & in acid-base balance.
- Potassium functions principally as the cation of cells.
- K is important for nerve & muscle excitability, and carbohydrate metabolism.
- Chlorine is associated with Na & K in osmotic regulation.
- Chlorine is important for gastric secretion, as HCl as well as chloride salts.

- Deficiency leads to lowering of osmotic pressure, results in dehydration.
- Na deficiency include poor growth, reduced utilization of proteins & energy.
- Weakness, paralysis, increased urination, irregular heartbeat (arrhythmia), orthostatic hypotension, muscle pain, tetany.
- Cl deficiency lead to an abnormal increase of the alkali reserve of the blood (alkalosis) caused by an excess of bicarbonate, since inadequate levels of chlorine in the body are partly compensated for by increases in bicarbonate.
- Animal products, especially meat and foods of marine origin, are rich sources of sodium.
- Chlorine is present in nature in association with sodium as sodium chloride
- All green roughages are good sources of potassium.

SULPHUR

- **Sulphur in the body occurs in proteins containing AA - *cystine, cysteine & methionine* mostly.**
- ***Biotin & thiamine and* hormone *insulin* and metabolite *coenzyme A* also contain sulphur.**
- ***Chondroitin sulphate* is a component of cartilage, bone, tendons and the walls of blood vessels.**
- **Sulphur-containing compounds are also important for respiratory process from haemoglobin through to cytochromes.**
- **Sulfur requirements of animals are satisfied through the protein supplementation**

MAGNESIUM

- Magnesium is closely associated with calcium and phosphorus.
- Magnesium is the commonest enzyme activator.
- In rats fed on purified diets, the symptoms include increased nervous irritability and convulsions.
- Hypertension, cardiovascular disease, Vitamin K deficiency, depressed immunity, depression, diabetes, erectile dysfunction, increased levels of stress, insomnia and migraine.
- Most of the feeds that are fed to animals are rich sources of magnesium.

SIGNIFICANCE OF SOME TRACE MINERALS IN LAB ANIMALS

IRON

- More than 90 % of iron in the body is combined with proteins, being *haemoglobin*.
- Fe occurs in blood serum in a protein called transferrin (transport of Fe from one part of the body to another.
- Ferritin, a protein containing iron, is present in spleen, liver, kidney & bone marrow and provides a storage for iron (hemosiderin is a similar storage).
- Deficiency of Fe affect haemoglobin synthesis and results in anaemia.
- Green leafy materials, most leguminous plants and seed coats.
- Foods of animal origin, such as meat, and fish, are excellent sources of iron.
- Iron is absorbed throughout the GIT, but mainly in the duodenum and jejunum.
- Absorption is poor and is, to a large extent, independent of the dietary source.
- The *mucosal block theory* is still widely accepted.

COPPER

- Copper is present in certain plasma proteins such as *ceruloplasmin.*
- Copper is also a component of other proteins in blood like erythrocuprein (erythrocytes) & plays a role in oxygen metabolism.
- Play vital role in many enzyme systems, a component of *cytochrome oxidase*, which is important in oxidative phosphorylation.
- Copper is necessary for the normal pigmentation of hair.
- Deficiency of Cu includes, anaemia, poor growth, bone disorders, scouring, infertility, depigmentation of hair, gastro-intestinal disturbances & lesions in the brain stem & spinal cord.
- Copper is present in adequate amount in most of the concentrate sources.
- Animal origin protein sources are good sources of copper.

IODINE

- **Iodine is involved in the synthesis of the two hormones, triiodothyronine and tetraiodothyronine (thyroxine) produced in the thyroid gland.**
- **Deficiency causes enlargement of the thyroid gland, termed *endemic goitre*, and is caused by compensatory hypertrophy of the gland.**
- **The richest sources of this element are foods of marine origin such as seaweeds and fish.**

MANGANESE

- Manganese is an activator of many enzymes such as hydrolases, kinases and constituent of arginase, pyruvate carboxylase & manganese superoxide dismutase.
- Manganese through its activation of glycosyl transferases, required for formation of the mucopolysaccharide which forms organic matrix of bone.
- Manganese deficiency has been found to cause retarded growth, skeletal abnormalities, ataxia of the new born and reproductive failure.
- Wheat bran, dried yeast & most vegetable protein concentrate, especially cottonseed cake & linseed cake, are good sources.

ZINC

- High concentrations of zinc have been found in the skin, hair.
- Several enzymes are known to contain zinc, includes carbonic anhydrase, pancreatic carboxypeptidase, lactate dehydrogenase, alcohol dehydrogenase, alkaline phosphatase & thymidine kinase.
- In addition zinc is an activator of several enzyme systems.
- Deficiency causes subnormal growth, depressed appetite, and parakeratosis.
- Yeast is a rich source, bran and germ of cereal grains.
- Animal protein products such as meat and fish are usually richer sources of the element than plant protein supplements.

SELENIUM

- **Selenium is component of *gluthathione peroxidase*, which catalyses the removal of hydrogen peroxide & protecting cell membranes from oxidative damage.**
- **Glutathione peroxidase forms a second line of defence after vitamin E.**
- **Se has a sparing effect on vitamin E by ensuring normal absorption of the vitamin.**
- **Se preserves the integrity of pancreas & ensuring satisfactory fat digestion.**
- **Vitamin E spares selenium by maintaining the element in its active form and preventing its loss & reduces the production of hydroperoxides and thus the amount of glutathione peroxidase needed to protect cells.**

MOLYBDENUM

- A component of xanthine oxidase.
- Molybdenum participates in the reaction of the enzyme with cytochrome C and also facilities the reduction of cytochrome C by aldehyde oxidase.

SIGNIFICANCE OF FAT SOLUBLE VITAMINS IN LAB ANIMALS

Vitamin - A

- Vitamin A, combines with a protein opsin to form Rhodopsin – which is a photoreceptor for light at low light intensities.
- Vitamin A is involved in the formation & protection of epithelial cells (anti-infective vitamin).
- It is essential for normal bone formation & protein metabolism.
- Deficiency causes roughened hair, scaly skin, cloudiness of cornea leading to xerophthalmia, nyctalopia or night blindness, constriction of optic nerve canal.
- Oils from livers of certain fish (Cod and Halibut) egg yolk, milk fat.
- Precursors is carotenoids which can be converted to vitamin A in plants.
- Foods rich in carotenoids include carrot, papaya, mangoes & leafy vegetables.

Vitamin – D

- In young deficiency of vitamin D causes rickets & in adults it causes osteomalacia.
- **Rickets:** Ca & P deposition in bones is affected and the bones are weak, more prone to fractures & deformities (bowing of legs, swollen knees & arching of back). Rickety Rosary – enlargement of Osteochondral junction in ribs are also noticed.
- **Osteomalacia:** Resorption affected & bones become weak, more prone to fractures and deformities.
- Liver oils of fishes such as cod and halibut (rich source).
- Egg yolk and sundried grains.
- Provitamin, ergosterol in plant sources & in animal sources, 7-dehydrocholestrol.

Vitamin - E

- Vitamin E functions as biological antioxidant, in association with the Se containing enzyme glutathione peroxidase, it protects cells against oxidative damage caused by free radicals.
- Plays role in development & function of the immune system.
- Vitamin E deficiency causes muscle degeneration (myopathy).
- Nutritional myopathy is also known as muscular dystrophy.
- In some instances sterility is also caused due to its deficiency.
- Greens, cereal grains, vegetable oils, fats, and nuts, oil seeds and legumes.

Vitamin - K

- Vitamin K is needed for the synthesis of prothrombin in the liver
- Low Prothrombin level in blood leads to haemorrhagic conditions.
- Vitamin K deficiency causes anemia and delayed clotting time of blood.
- Green leafy vegetables, Egg yolk, Liver, Fish and synthesised by bacteria in GI tract.

SIGNIFICANCE OF WATER SOLUBLE VITAMINS IN LAB ANIMALS

Thiamine

- Thiamine diphosphate is a coenzyme involved in oxidative decarboxylation of pyruvate to acetyl coenzyme A & alpha-ketoglutarate to succinyl COA in TCA cycle.
- Deficiency causes, beri beri, weight loss, impaired sensory perception, weakness and pain in the limbs, irregular heart rate & edema.
- Yeast, germ of cereal grains, beans, leafy vegetables, egg yolk, liver, kidney & pork is rich in thiamine.

Riboflavin

- It is a constituent of flavoproteins.
- They are involved in amino acid and carbohydrate metabolism.
- Deficiency causes, poor appetite, retarded growth, vomiting, skin eruptions and eye abnormalities.
- Synthesised by yeast, bacteria and fungi.
- Rich sources are liver, yeast, milk and green leafy vegetables.

Niacin

- Nicotinamide is active group of two important coenzymes, nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP).
- Deficiency causes dermatitis.
- It can be synthesised from amino acid Tryptophan in body tissues.
- Rich sources of the vitamin are liver, yeast and groundnuts. In cereals the vitamin is present in the bound form.

Vitamin - B6

- Pyridoxal phosphate plays a central role as coenzyme in the reactions by which a cell transforms nutrient amino acids into mixtures of amino acids & other nitrogenous activities of transaminases and decarboxylases.
- Deficiency affects the growth rate, reduced appetite, anemia may develop and convulsions may also occur.
- Widely distributed yeast, pulses, cereal grains, liver and milk .

Pantothenic acid

- Pantothenic acid is a constituent of coenzyme A, which is the important coenzyme of acyl transferase.
- Pantothenic acid deficiencies are considered to be rare in practice because of the wide distribution of the vitamin.
- Rich sources are liver, egg yolk, groundnuts, peas, yeast and molasses.
- Cereal grains and potatoes are also good sources of the vitamin.

Folic acid

- After absorption into the cell, folic acid is converted into tetra-hydrofolic acid which functions as a coenzyme in the mobilization and utilisation of single-carbon groups.
- Folic acid is widely distributed in nature, green leafy materials and cereals are good sources of the vitamin.
- Deficiency causes poor growth, anaemia, poor bone development & congenital malformations including neural tube defects.

Choline

- Essential structural component of body tissues.
- Component of lecithin (play a vital role in cellular structure & activity).
- Plays an important part in lipid metabolism in the liver by preventing the accumulation of fat.
- It serves as a donor of methyl groups in transmethylation reactions.
- Component of acetylcholine which is responsible for the transmission of nerve impulses.
- Choline can be synthesized in the liver from methionine & level of methionine in the diet therefore influences the exogenous requirement for this vitamin.
- Deficiency causes slow growth & fatty infiltration of the liver.
- Green leafy materials, yeast, egg yolk and cereals are rich sources of choline.

Biotin

- Part of the vitamin B complex, biotin is chemically 2-keto-3, 4 imidazolidine 2-tetrahydrothiophene-n-valeric acid.
- Biotin serves as the prosthetic group of several enzymes which catalyse the transfer of carbon dioxide from one substrate to another.
- In animals there are three biotin-dependent enzymes of (pyruvate carboxylase, acetyl coenzyme A carboxylase an& propionyl coenzyme A carboxylase).
- Deficiency causes foot lesions, alopecia (hair loss), dry scaly skin.
- Avidin, a protein present in the raw white of eggs can induce biotin deficiency, which combines with biotin & prevents its absorption from the intestine.
- Biotin is widely distributed in foods like liver, milk, yeast, oilseeds and vegetable are rich sources.

Vitamin - B12

- Part of several important enzyme systems like isomerases, dehydrases & enzymes involved in the biosynthesis of methionine from homocysteine.
- Vitamin B12 is synthesized exclusively by microorganisms and its presence in foods is of microbial origin.
- Deficiency causes irreversible damage, especially to the brain and nervous system.
- The natural sources of the vitamin are foods of animal origin, liver is particularly rich source.

Vitamin - C

- Plays an important role in the oxidative reduction reaction of living cells.
- Formation of collagen & intercellular cement substance (Capillaries, teeth, bone).
- Metabolism of tyrosine.
- Absorption of Fe and incorporation of plasma Fe into ferritin.
- Hydroxylation of deoxycorticosterone, tryptophan, phenylalanine.
- Vitamin C is dietary essential only in man, other primates, guinea pig, red vented bulbul & fruit eating bat (because these species lack the enzyme L-gulonolactone oxidase), while other species synthesise vitamin C from glucose.
- Deficiency causes scurvy, weakness, bleeding, loosening of teeth, swollen joints & haemorrhages.
- Citrus fruits and green leafy vegetables.

Discussions……..

Questions, if any……??

THANKS