Quite apart from the molecular role of vitamin A (a lipid soluble micronutrient) in the light sensing molecules in the eye, it has been demonstrated as an indispensable factor required for the normal functioning of a broad spectrum of biochemical and physiological activities. The broad area of activities includes, reproduction, cellular differentiation, growth, synthesis and secretion of various biogenic molecules in the system. Underlying the clinical signs leading to the tragic sequelae in the above mentioned activities are a number of molecular changes, some well defined and some not, which result when vitamin A is absent from the diet. However, the raging controversy about the finer details of the mechanism(s) of its action to account for an array of manifestation, leaves an open challenge to all concerned.

Vitamin A deficiency, often in association with protein energy malnutrition, parasitic infestation (fetal vitamin A malnutrition) and diarrheal disease, is a major nutritional problem among the pre-school children in many areas of the world. There are many reports in the literature indicating the association of various eye lesions with protein energy malnutrition (PEM). The exact biochemical mechanism of this dual deficiency is not fully understood. The present study deals with the various aspects of protein vitamin A interrelationship in metabolism, role of vitamin A in cellular growth and differentiation in rats and how vitamin A is transferred from mother to her offspring. In the present series of investigations
The following studies have been carried out.

A. To evaluate the influence of quality and quantity of plant protein (bengal gram) on vitamin A metabolism in rats, the hepatic stores of vitamin A, its mobilization in plasma and its uptake by target tissues from the plasma were studied in the rats given a single massive dose of vitamin A. Growing Wistar strain male rats (40–60 grams) were allocated into four groups and pair fed casein and bengal gram diets at 20 percent and 10 percent protein levels for a period of two weeks. Twenty four hours before sacrifice the above groups were further divided into two subgroups. To one subgroup a single massive dose of vitamin A (20,000 IU/100g body weight) was administered orally and to other subgroup vehicle alone was given. After sacrifice the tissues were removed and processed for vitamin A isolation and quantitation.

To assess the in vitro release of vitamin A from liver to plasma of rats fed either casein or bengal gram diets at 20 percent and 10 percent protein level, $^3$H-retinyl acetate (20 μci or 0.74 MBq/100g body weight) was injected intraperitoneally. In other experiment the in vitro uptake of radioactive vitamin A from $^3$H-retinyl acetate labelled plasma, by various extra hepatic tissues was studied. The salient features of these studies are as follows:

1. Feeding of bengal gram diet at 20 percent and 10 percent protein levels for a period of two weeks, resulted in reduced growth rates of rats as compared to the rats fed casein diet at
the same protein levels.

2. Feeding of low quantity of casein or bengal gram proteins resulted in reduced organ weights, however no effect of quality of these proteins on the organ weights of growing rats was observed.

3. The hepatic stores of vitamin A were profoundly decreased by the poor quality and quantity of dietary proteins in control as well in rats given 20,000 I.U. of vitamin A.

4. Feeding of low quantity of dietary proteins resulted in the decreased plasma vitamin A levels.

5. The in vitro release of radioactive vitamin A from the liver slices was greater in rats fed casein and bengal gram diets at the low protein levels.

6. The in vitro uptake of $^3$H-retinol from $^3$H-retinyl acetate labelled plasma medium, by extrahepatic tissues slices was lower in bengal gram diet fed rats as compared to casein diet fed rats.

7. It is concluded that poor quality and inadequate quantity are both detrimental influences on vitamin A status of the growing rat.

B. To evaluate the role of vitamin A in fetal growth and development, studies have been carried out using hypovitaminotic A female rats. Wistar strain female rats (160-180g) were fed vitamin A deficient diet for a period of one week and on eighth day of feeding, these female rats were mated with normal male rats of the same strain. After conception, the pregnant rats were given low (6 µg retinol equivalents/day/Kg body weight), medium (40 µg retinol
equivalents/day/kg body weight) and adequate (100 µg retinol equivalents/day/kg bodyweight) supplement of vitamin A. To assess the transport of vitamin A via placenta or milk, the vitamin A contents of placenta, fetus and liver, lung, heart and brain of pups were estimated at various periods of development. In other series of experiments, the developmental pattern of these organs in parameters of tissue weight; DNA, RNA and protein contents; fatty acids and cholesterol contents; enzyme activities of pyridine nucleotide linked dehydrogenases and citrate cleavage enzyme activity was studied in relation to maternal vitamin A status. The salient features of these investigations are as follows:

1. The gain in body weight of pregnant rats was dependent on their intake of vitamin A, being lowest in the low vitamin A supplemented dams and highest in the adequate vitamin A supplemented dams.

2. The low intake of vitamin A by pregnant mothers resulted in the reduced total litter size and prolonged gestation period (upto 25 days).

3. The growth pattern of pups showed the remarkable decrease in the body weight of pups derived from low vitamin A supplemented group as compared to adequate vitamin A supplemented group during postnatal development of pups.

4. The maternal vitamin A restriction caused paralysis of fore-limbs, eye lesions (xerophthalmia) and ultimately loss of vision in the pups derived from low vitamin A supplemented group during their postnatal development.
5. The maternal hepatic stores of vitamin A in various groups were related to their vitamin A intake being lowest in the low group and highest in the adequate group, during pre- and postnatal development of fetus.

6. The plasma vitamin A levels of dams in all the three groups (low, medium and adequate) were comparable during pregnancy and suckling.

7. At 14th day of gestation the vitamin A contents of placenta and fetus were drastically reduced due to low intake of vitamin A by the dams.

8. The liver vitamin A stores of the pups increased with its development and the increase was dependent on the supply of vitamin A to the dams during the development of fetus.

9. Like hepatic stores, the vitamin A contents of the developing organs viz. lung, heart and brain of pups increased with their development, however the maternal vitamin A restriction significantly decreased the vitamin A distribution in these organs.

10. Low supplementation of vitamin A to the pregnant mothers resulted in the reduced tissue weight, DNA, RNA and protein levels, cell number and the incorporation of $^3$H-leucine into proteins of the fetus at 14th day of gestation.

11. The developmental pattern of liver, lung, heart and brain showed a fairly linear increase with the age, in the parameters of tissue weight, cell number and their DNA, RNA and protein contents; incorporation of $^3$H-thymidine into DNA and $^3$H-leucine into protein (DPM/organ) in all the three (low, medium and adequate) groups.
Maternal vitamin A restriction significantly reduced these parameters in low group as compared to medium and adequate groups at various periods of development of these organs. The turnover of proteins and the cell size in these organs either remained unchanged or decreased with the development of fetus. Therefore, it is concluded that vitamin A is indispensable for the cellular differentiation and growth of the organs in rat.

13. Maternal vitamin A restriction profoundly reduced the total fatty acids and cholesterol contents of the fetuses and the incorporation of $^3$H-acetate into these lipid constituents in low group at 14th day of gestation.

14. The developmental pattern of total fatty acids in liver, lung, heart and brain of pups was nearly identical in all (low, medium and adequate) groups. Maternal vitamin A restriction did not affect the total fatty acid contents of these organs during gestation but profoundly reduced total fatty acid contents in these organs were noted during the postnatal development of pups.

15. The increase in cholesterol contents of liver, lung, heart and brain of pups was fairly linear with the age. Low intake of vitamin A by the dams significantly reduced the total cholesterol contents of liver and heart at 20th day of gestation and 10th day of postnatal age. In lung and brain the total cholesterol contents were reduced in low group as compared to adequate group during their postnatal development.

16. The developmental pattern of lipogenesis and cholesterogenesis from $^3$H-acetate in liver lung, heart and brain showed a steady
increase with the age and the pattern was nearly similar in all
the groups. The turnover of fatty acids and cholesterol i.e. the
specific activity sharply increased during gestation, reached
a maximum at 10th day of postnatal age and thereafter it
plateaued off. Maternal vitamin A restriction profoundly reduced
the lipogenesis and cholesterogenesis (DPM/organ) and the turnover
of these lipid constituents during the prenatal and postnatal
development of the organs.

16. Low intake of vitamin A by dams resulted in profound decrease
in the activities of lipogenic enzymes viz. combined HMP shunt
dehydrogenases, malic enzyme, iso-citrate dehydrogenase and
citrate cleavage enzyme in the fetuses at 14th day of gestation.

17. The developmental pattern of total activity of combined
HMP-shunt dehydrogenases showed the peak value at birth and then
it decreased in liver, lung, heart and brain of pups derived
from three different groups. Dietary vitamin A restriction of
the mother profoundly reduced the activities of these enzymes in
the organs at various periods of development.

18. Malic enzyme total activity increased linearly with the age
till 10th day of postnatal age in all the organs studied.
The maternal vitamin A restriction significantly reduced the malic
enzyme activity in the pups derived from low vitamin A
supplemented dams as compared to those derived from adequate
vitamin A supplemented dams at various periods of prenatal and
postnatal development.
19. The developmental pattern of isocitrate dehydrogenases showed the increase in total activity in liver and lung of pups during gestation and suckling periods, but in heart and brain it was comparable at these periods. Low intake of vitamin A by dams significantly reduced the isocitrate dehydrogenase activity during pre and postnatal development of these organs.

20. Citrate cleavage enzyme showed a steady increase in the total activity with the age in liver, lung, heart, and brain of pups derived from low, medium, and adequate groups. Maternal vitamin A restriction significantly reduced the citrate cleavage enzyme activity during gestation and postnatal development of these organs.

From these observations it may be concluded that:

(i) Quality and quantity of dietary proteins affect the vitamin A absorption, storage in liver, mobilization from liver to plasma and its uptake by various extra hepatic tissues.

(ii) Vitamin A is an indispensable micronutrient for cellular differentiation, growth and maturation processes in liver, lung, heart, and brain of rats.