

# PESTICIDES IN FOOD CHAIN AND THEIR IMPACT ON ANIMAL AND HUMAN HEALTH

**R. S. Chauhan**

Centre for Animal Disease Research and Diagnosis  
Indian Veterinary Research Institute, Izatnagar-243 122 (UP)

In the thirst of modernization and industrialization man has contributed pollution to the life and ecology of plants, animals and microbes. Increased demand for food and fiber has led to the chemicalization of agriculture and we have reached on such a stage that modern agriculture is dependent on high yielding varieties, which can only be grown under the influence of fertilizers and pesticides. Pesticides are the man made chemicals which are being used to produce enough cheap food. In India, 90,000 MT of technical grade pesticides are used annually to control pests and plant diseases. The pesticides are classified as insecticides, fungicides, weedicides, herbicides, nematocides and rodenticides; of which insecticides constitute 77% of the total pesticides used in different agricultural and animal husbandry practices and in public health operations.

Majority of these pesticides are beneficial when used for specific purposes, handled properly and applied as per the recommendations of the manufacturer. However, over the years, there has been a mounting fear and concern that indiscriminate and disproportionate use of pesticides may lead to their residues in food chain which may exert their harmful effects in human beings and animals. In an ideal pesticide application, the chemical should fall exactly on the target and be degraded completely to harmless compounds but this never occurs and only some part of the pesticide hits the target pests while remaining drifts into the environment.

If we look retrospectively, we find that the use of pesticides started during second world war when these hazardous and toxic poisons were considered as chemical weapons. A Swiss scientist Paul Muller invented DDT in the year 1939 which was considered as a wonder chemical that kills the insects, pests and was found wonderful in malaria control programmes. But soon after the discovery of DDT, its harmful effects also came into the knowledge of the scientists. In 1944, A famous biologist found harmful effects of DDT in birds, which produced thin shelled eggs, easily broken in nests resulting into failure of reproduction and decline of bird population.

The amount of pesticides used in India is very low (only 0.5 kg/ha) as compared to other developed countries (Table 1), even then we have much higher pesticide residues in food of our country.

Table 1. Consumption of pesticides in different countries

	<b>Country</b>	<b>Consumption (kg/ha)</b>
1.	India	0.5
2.	Korea	6.6
3.	USA	7.0
4.	Germany	3.0
5.	Japan	12.0
6.	Europe	2.5
7.	Mexico	0.75

There is a gradual increase in production and consumption of pesticides during last few decades. The pesticides consumption increased from 2353 MT during 1955 to 75033 MT (technical grade) in the year 1991-1992 and which is again in the decline phase with the adoption of integrated pest management practices and the pesticides consumption level declined to the level of 43020 MT (technical grade) in the year 2003-2004 (Table 2).

Table 2. Consumption of pesticides in India

	<b>Year</b>	<b>Pesticides (MT)</b>
1.	1955-56	2353
2.	1960-61	8620
3.	1970-71	24320
4.	1980-81	54775.49
5.	1991-92	75033
6.	1995-96	61260
7.	1996-97	56114
8.	1997-98	52239
9.	1998-99	49157
10.	1999-00	46195
11.	2000-01	43584
12.	2001-02	47020
13.	2002-03	48350
14.	2003-04	43020

Source: Directorate of Plant Protection and Quarantine, Faridabad

About 20% of Indian food products contain pesticide residues above tolerance level compared to only 2% globally. No detectable residues are found in 49% Indian food products compared to 80% globally. It is all because of following reasons which needs to be looked in order to reduce the level of pesticide residues in animal products and other food material below MRL value. Table 3 includes the MRL in meat and eggs.

Table 3. Maximum residual level (MRL) {mg/ kg (ppm)} of some commonly used pesticides in animal products.

	<b>Name of the pesticide</b>	<b>Animal product</b>	<b>Maximum residual level mg/kg (ppm)</b>
1.	Aldrin/ Dieldrin	Meat Egg	0.2 0.1
2.	Benomyl	Meat Egg	0.1 0.1
3.	Carbendazim	Meat Egg	0.1 0.1
4.	Chlorpyrifos	Meat Egg	0.1 0.1
5.	Carbofuran	Meat Egg	0.1 0.1
6.	Chlorfenviphos	Meat Egg	0.2 0.2
7.	Cypermethrin	Meat	0.2
8.	2,4-D	Meat Egg	0.05 0.05
9.	DDT	Meat Egg	7.0 0.5
10.	Edifenphos	Meat Egg	0.02 0.01
11.	Ethion	Meat Egg	0.2 0.2
12.	Fenthion	Meat	2.0
13.	Fenvalerate	Meat	1.0
14.	Fexachloricyclohexane (HCH)	Meat Egg	2.0 0.1

15.	Lindane	Meat Egg	2.0 0.1
16.	Monochrotophos	Meat Egg	0.02 0.02
17.	Phenthioate	Meat Egg	0.05 0.05
18.	Primiphos methyl	Meat Egg	5.0 0.05
19.	Carbofuran	Meat	0.1
20.	Phenthoate	Meat Egg	0.05 0.05

## Reasons for more pesticide residues in India

### 1. Indiscriminate use of pesticides

The use of pesticides is comparatively more in certain crops while in some it is negligible (Table 4). The farmers use pesticides more frequently and in increased doses than the recommended doses or procedures. It leads to the presence of high amount of residues in food commodities.

Table 4. Pesticides share in different crops

	Name of the Crop	Percent share of pesticides
1.	Cotton	52-55
2.	Rice	17-18
3.	Vegetables/ Fruits	13-14
4.	Plantation	7-8
5.	Cereals/oil seeds	6-7
6.	Sugarcane	2-3
7.	Others	1-2

### 2. Improportionate use of pesticides

The pesticides are used improportionately in India in relation to places and the amount of pesticides residue varies from one place to another. Tamilnadu consumes 1.2-2.0 kg/ha of land followed by Andhra Pradesh and Punjab where 0.8-1.2 kg is the rate of consumption. Pesticide residues in the feed and fodder are solely responsible for their accumulation in animal and poultry. The states like Tamilnadu, AP, Punjab, Haryana, and Karnataka have highest use of pesticides in order to get more production while on the other hand the states like Bihar, West Bengal, North eastern states have lowest use of pesticides. It is because of illetracy of farmers, poor economic conditions or due to lack of awareness. So the food commodities in high using states have more residues of pesticides.

### 3. Lack of education

Most of the farmers or labours working in the agricultural fields are either illiterate or having low formal education. They are not able to understand and read the instructions mentioned on pesticide containers or in the literature supplied with them. Their tendency is to use comparatively higher quantity of pesticides than recommended by the scientists/manufacturers. They ignore the required dilution factor and use much higher concentration of the pesticides. They are even not aware of the harmful effects of the pesticides and do not properly dispose the used containers of the pesticides.

#### 4. Lack of extension activities

In spite of Krishi Vigyan Kendra, Krishi Gyan Kendras and a network of extension workers of the Government/ NGO's, there is a lack or deficiency in proper extension activities in India. The farmers are not fully aware about how to use pesticides, what precautions they should take in order to reduce the acute and chronic effects of pesticides? Farmers do not keep proper difference between the last application of pesticide and harvesting the crop, which leads to increased level of pesticide residue in food items and ultimately in animal products.

#### 5. Inadequate literature supplied by the manufacturers

The pamphlets/ literature supplied by the manufactures along with the pesticide packing is incomplete and inadequate. Though it is written in many regional languages/ scripts but the printing, letter size and quality of paper is so poor that even an educated person cannot read and understand it what to talk of farmers or labours. It has been observed that one of the reasons to use a much higher concentration than the recommended ones is lack of proper literature.

#### 6. For want of more production and profit

Most of the farmers have impression in their mind that spray/use of more pesticide will lead to higher production. Therefore, the desire of more production and profit leads to indiscriminate use of pesticides in crops which ultimately enters in the food chain.

#### 7. Lack of safer pesticides

So far very few pesticides have been discovered which are harmless to human being or other domestic animals. Therefore, farmers have to use the available pesticides only which have a very narrow safety margin.

#### 8. Use of banned pesticides

In our country most of the banned pesticides (Table 5) are available in market and are used in various agricultural operations. This is primary because of the failure of Govt. to formulate and implement effective policies regarding the use of pesticides. Secondly, the socioeconomic condition of farmers does not allow to strictly monitoring the use of dangerous pesticides in agriculture and animal husbandry. These pesticides have been banned because of their acute/chronic harmful effects on the animal/human health. Thus their use adds to the misery and poor health of farmers and consumers.

In spite of ban, DDT and BHC are still produced in India and we have 77% DDT and 95% BHC in India out of their total production in world.

Table 5. Pesticides Banned in India

	Name of the Pesticide	
1.	Aldicarb	
2.	Aldrin	
3.	Benzene Hexachloride (BHC)	
4.	Calcium cyanide	
5.	Captafol 80% Powder*	Use banned w.e.f. 17.7.2003
6.	Chlordane	
7.	Chlorobenzilate	Use banned w.e.J. 17.7.2003
8.	Cibromochloropropane	
9.	Copper Acetoarsenite	
10.	Dieldrine	Use banned w.e.f. 17.7.2003

11.	Endrin	
12.	Ethylene Dibromide	Use banned w.e.f. 17.7.2003
13.	Ethyl Mercury Chloride	
14.	Ethyl Parathion	
15.	Heptachlor	
16.	Maleic Hydrazide	Use banned w.e.f. 17.7.2003
17.	Menazone	
18.	Mehtomyl 12:5% L	
19.	Mehtomyl 24% L	
20.	Nicotine Sulphate*	
21.	Nitrofen	
22.	Paraquate Dimethyl Sulphate	
23.	Pentachloro nitrobenzene (PCNB)	
24.	Pentachlorophenol (PCP)	
25.	Phenyl Mercury Acelate (PMA)*	
26.	Phosphamidon 85% SL	
27.	Sodium Methane Arsonate (MSMA)	
28.	Tetradifon	
29.	Toxafen	
30.	Trichloro acetic acid (TCA)	Use banned w.e.f. 17.7.2003

\*Manufactured in India for export only

Source: Directorate of Plant Protection and Quarantine, Faridabad

## 9. Man is ultimate consumer

Man is the ultimate consumer of pesticide residues. Through fodder, water, air and other feed stuffs pesticide residues reaches in animals and then through milk, meat, egg and other animal products accumulates in human being. Various pesticide residues have been reported from animal products in our country important among them are DDT, Carbaryl, Heptachlor, PCB etc. These pesticide residues in animal products and other food items ultimately get accumulated in the man especially in the adipose tissue, blood and lymphoid organs. Most of research on pesticide toxicity has been directed towards the assessment of their acute effects. When fed to man or animals at very low doses daily for months or years, these accumulated pesticides in body, may harm the normal functions causing various diseases in man and animals.

### Status of pesticide residues in India

The presence of pesticide residues have been detected in various items and in food chain. The levels of the pesticides are found much higher than expected level because of heavy contamination of environment. A list of commodities is given in which very significant levels of pesticides are recorded (Table 6). Besides, there are human milk, fat or tissue samples screened for the presence of pesticide residues were also found to have very significant levels of harmful pesticides. The BHC has been found from 0.120 to 1.22 PPM in human fat samples. Heptachlor, an organochlorine pesticide was found to be 0.425 PPM and DDT from 0.195 to 1.695 PPM. Even human breast milk is not free from DDT, which was found to have even 2.39 PPM levels. Similarly human blood was found to have a much higher concentration of 12.00 PPM as against of 0.050-PPM safe levels (no effect levels).

Table 6. Pesticide residues in food chain

	Items	Pesticide residues detected
1.	Soil and water	Permethrin, cypermethrin, fenvelerate, deltamethrin, DDT, Aldrin, Dieldrin, BHC, Heptachlor, Lindane, Endosulfan
2.	Air	DDT, BHC
3.	Fodder (Lucerne)	Monocrotophos, Phosphomidon, Endosulfan
4.	Cattle feed	Cypermethrin, DDT, BHC
5.	Pasture & Hay	DDT, Aldrin, Dieldrin, BHC, Heptachlor, Lindane
6.	Rice, wheat flour, oils	DDT, BHC
7.	Dairy Products, Baby milk powder, Butter, Ghee, Cow/ buffalo milk	DDT, BHC, HCB, PCB, Heptachlor
8.	Meat, Eggs	DDT, heptachlor, PCB, Carbaryl
9.	Liver, Kidneys, Hair, skin	Cypermethrin
10.	Vegetables	Endosulfan
11.	Adipose tissue of man	BHC, DDT, PCB, HCB, Heptachlor, Aldrin
12.	Human breast milk	BHC, DDT, Aldrin, Heptachlor, HCH
13.	Blood of man	BHC, DDT, Aldrin, Heptachlor, HCH

The primary concern of the chronic low dose toxicity in man and animals is related to the carcinogenic, teratogenic, mutagenic, immunotoxic, immunopathological and/or neuropathic effects of pesticides. The perusal of literature in this regard reveals the studies directed towards only one or two pesticides while in nature, when a large number of pesticides are present and their combined effect has not been measured; which of course will give very dangerous view. Various Pathological effects of low doses of pesticides in animals and man are as under:

### 1. Immunopathological effects

Immunopathological effects of pesticides in animals and man are classified under acquired immunodeficiency or immunosuppression, autoimmunity and hypersensitivity.

- a) **Acquired Immunodeficiency:** Most of the pesticides studied during last two decades are found to exert immunosuppressive effect on both the wings of immune system i.e. humoral and CMI. Organochlorines, organophosphates, carbamates and synthetic pyrethroid pesticides were found immunotoxic at “no adverse effect dose” levels in poultry, sheep, and in bovine calves. However, the organochlorines are comparatively much more harmful to immune system. They are considered to be the cause of vaccinal failures or occurrence of disease epidemics in animals due to lowered immunocompetence. It has also been reported that a state of immunosuppression for a longer period may also lead to the development of neoplasms as the immune surveillance mechanism becomes defective. Such animals also exhibit recurrent bacterial infections due to defective phagocytic machinery of the body. Immunosuppressive state of animal for a longer duration may also lead to development of cancers in the absence or defective immune surveillance in body. Since the pesticides affect specific as well as paraspecific immune system adversely, the immuno surveillance in body becomes defective. Though, there is no direct correlation but for an example, there is an increased incidence of eye cancer (squamous cell carcinoma of

eye) in cattle and buffaloes in western UP during last few years. Similarly the occurrence of canine venereal tumours also increased in dogs during last decade. It is an indication of the adverse effects of polluted environment and may be related with a state of immunosuppression.

- b) **Autoimmunity:** Pesticides are also known to initiate autoimmune reactions in body particularly organochlorine group of pesticides binds with certain proteins of the body to become antigen leading to initiation of an autoimmune response in body. Autoimmune glomerulonephritis or autoimmune hemolytic anemia or autoimmune rheumatoid arthritis are such manifestations in animals and man. Lindane when fed with 'no adverse effect dose' level in lambs for a period of 4 months resulted in autoimmune glomerulonephritis as has been detected by the presence of immunocomplexes in glomerular basement membrane using indirect immunoperoxidase techniques.
- c) **Hypersensitivity:** Hypersensitive reactions are reported due to consumption of pesticide contaminated food stuffs. Pesticides may act as haptens but antibodies against them have been detected in body. Eczema in man was found due to maneb, 2,4-D and 2,4,5-T. DDT has also been known to cause type I hypersensitivity reaction. The dust of pesticides is cause of allergic respiratory disorders like asthma. Cutaneous allergy has been known to occur due to contact of pesticide contaminated food items. However, the studies showed a depression of CMI response on delayed type hypersensitivity reaction using chemical allergens.

## 2. Carcinogenic effects

Some pesticides exert their carcinogenic effects either directly or indirectly through their metabolites. Most of organochlorine pesticides like dieldrin, gamma isomer of BHC, DDT and PCB may cause cancer in liver and lung. However, there is a lack of sufficient literature to support this belief that the pesticides are having carcinogenic effects. Indirectly, a state of immunosuppression for a longer period is helpful in increasing the susceptibility of an animal for malignancy. Since many pesticides are known to cause mutation in chromosomes of man and animals, it is considered that they may also lead to carcinogenicity.

## 3. Mutagenicity

Pesticides may cause alterations in structure or number of chromosomes resulting in translocations, mutations and chromosomal breakage. The altered chromosomal number may become lethal during fetal stage. Several pesticides like DDT, Endrin, PCB and HCB are known to cause chromosomal aberrations. The mutagenic effect of pesticide poses a more serious threat to the future of human race.

## 4. Teratogenicity

The accumulation of pesticides in body tissue and congenital birth defects in children has not been well correlated so far. However, there are certain pesticides which causes teratogenic defects in animals. Carbaryl, thiram, propoxur, parathion, leptaphos, 2,4-D, lindane and diazinon are having teratogenic defects in animals. In mice, cypermethrin, alphemethrin and malathian are found to exert birth defects in baby mice.

## 5. Neuropathy

Most of the organophosphates, organochlorines carbamates may cause neurotoxic effects in man and animals including increased irritation, loss of memory, in coordination of movement, ataxia, delayed response, convulsions, spasms and paralysis. Such changes appear due to demyelination of nerves in central and peripheral nervous system. Pesticide residues are also responsible for marked behavioural changes in man and animals.

## 6. Nephropathy

The pesticide residues present in food stuff may act as hapten and when they bind

with certain body proteins, they may become antigenic. This antigenicity is responsible for initiation of immune response in body and a continuous presence of antigen and antibodies in body may lead to the formation of immune complexes. The immune complexes when produced in excess are deposited in glomerular basement membrane leading to glomerulonephritis, commonly known as renal failure for which patient needs dialysis after a regular interval to survive.

### **7. Hepatotoxicity**

The pesticide residues in food may harm liver tissue as they are metabolized here. There are instances of chronic liver disorders leading to cirrhosis. Certain pesticides are not so dangerous but their metabolites cause severe damage to hepatic parenchyma. The cirrhosis once starts, it never stops even after withdrawal of the primary cause.

### **8. Reproductive Disorders**

It has been observed that the pesticides are lethal to dividing cells of genitalia. They may cause abnormalities in sperms leading to decrease their ability for fertilization. On the other hand the ova becomes defective and not able to implant on the uterine surface leading to early abortion or miscarriage. DDT has been found to cause weak egg shell in birds leading to their decreased population. The pesticide residues in food, thus may ultimately lead to sterility, early abortion, still births or repeat breeding.

### **9. Recurrent infections**

Animals having reduced immunocompetence due to pesticides are more liable to attract infections very frequently. A good treatment provides relief to animal but soon after recovery, the same disease occurs again due to immunosuppressive state of animal. Needless to emphasize that most of the antibiotics are bacteriostatic, which do not kill the organism but prevent their growth. In such conditions the suppressed growth of bacteria flares up just after withdrawal of the antibiotic therapy in the absence of defective immune system of body due to pesticides.

### **Cowpathy in control of harmful effect of pesticides**

Cowpathy is just like any other system of medicine such as Homeopathy, Allopathy or Naturopathy. In this, the human or animal ailments are treated with products of cow also known as Panchgavya means five things derived from cows i.e. milk, ghee, dahi, urine and dung. In our ancient literature of Ayurveda it is described as Panchgavya Chikitsa. In recent years, interest has been generated among scientific community of the world to develop or scientifically validate the Indigenous Technical Knowledge (ITK) as an alternate therapeutic or preventive approach. As is evident from the trends of modern allopathic treatments particularly the development of resistance in microorganisms and side effects, the alternative system of medicine gains momentum not only in India but WHO also established recognition to such systems. In fact in the western world also, scientists/ clinicians are facing problem in handling the multiple drug resistance in microorganisms, presence of antibiotic residues in food chain and/or associated allergies and autoimmune disorders in man. As per WHO, the twentieth century wonder drugs “antibiotics” will not remain useful and become almost ineffective by the year 2020, then one has to think over the alternative therapeutic approaches to control the infections. In fact most of the antibiotic drugs are bacteriostatic in nature and as such they do not kill the bacteria rather they stop or check their growth and bacteria have to be destroyed by the body’s own defence mechanism known as “Phagocytic System” through macrophages (monocytes of the blood). During last few years it has been observed that the efficiency of these macrophages reduced drastically as a result of the environmental pollution and presence of pesticides, heavy metals, fungal toxins etc. in the food chain. That is attributed to the heavy use of agrochemicals in agriculture and poor storage conditions of food grains. Any how deficient functioning of macrophages leads to inefficacy of antibiotic



drugs, development of resistance in bacteria, recurrent infections, and or decreased immune status of an individual. Recent researches showed that cow urine enhances the immune status of an individual through activating the macrophages and augmenting their engulfment power as well as bactericidal activity. This research opened a new era in medical science and CSIR has got a patent from US on cow urine for its bioenhancing properties and its use in tuberculous patients. Along with traditional therapy of tuberculous drugs, if one also consumes cow urine, the antituberculous drugs act faster even in low doses and thereby reducing the cost of treatment and its duration. Very recently, researches have found that use of cow urine along with the antibiotics prevents the development of resistance in microorganisms against the antibiotics. This is thought that the cow urine blocks the R-factor, a part of plasmid genome of bacteria responsible for the development of antibacterial resistance. Several scientists from different laboratories of CSIR, AIIMS, G.B. Pant University Pantnagar, and IVRI, besides NGOs are working on different medicinal properties of cow urine. In fact there are several medicinal preparations available with NGOs who are also marketing cowpathy drugs under FDA license and some of the NGOs are even not able to cope up with the demand of the public. Several students of M.Sc., M.V.Sc., M.D. and/or Ph.D. are working on the medicinal properties of cow urine and other products of cows. It has been found to enhance the body's immunity and resistance power to fight with infections. Cow urine has antioxidant properties and thus it neutralizes the oxidative stress produced in body through action on free radicals. It has been found to repair the damaged DNA and thus is effective for the cancer therapy. Scientists proved that the pesticides even at very low doses cause apoptosis (cell suicide) in lymphocytes of blood and tissues through fragmentation of DNA and cow urine helps the lymphocytes to survive and not to commit suicide, it also repairs the damaged DNA. Besides, in poultry cow urine enhances the immunocompetence of birds and provides better protection along with vaccination. It also increases egg production, egg shell quality and egg weight. Moreover, by using cow urine in poultry ration one can enhance the productivity that too without using antibiotics and the fear of antibiotic residues in poultry products.

On the basis of chemical fingerprinting through modern equipments like HPLC, it has also been observed during the scientific research that the urine of Indian cows are highly effective and almost nil or few medicinal properties are present in the urine of crossbred, exotic cows, buffaloes, etc. The Indigenous cow urine contains "Rasayan" tatva, which is responsible to modulate immune system and act as bioenhancer. It is not only the cow urine which is a wonder product by cow but others like dung, milk, ghee and curd are also equally effective for various ailments and other operations. Cow urine as such and/or after addition of neem leaves is a wonderful biopesticides. Such biopesticides are safe to use, do not accumulate in the food chain and as such do not have the harmful effects like chemical pesticides. Cow dung is an excellent farm yard manure and if processed and prepared vermi-compost, very small amount of vermi-compost is sufficient for a large field. Similarly, many medicines are prepared from the cow milk, ghee and curd. However, again the problem is same, scientific validation of these products is required.

Cowpathy is an age old system of medicine described in ancient Indian literature 'Ayurveda' as 'Panchgavya Chikitsa'. In Ayurvedic system, medicines are prepared either from plants or from animals besides the use of certain metals. The Ayurvedic medicines of animal origin are mainly prepared from cow products. The high profile medicine 'Panchgavya' is prepared from five materials received from cows that includes milk, Dahi (curd), Ghee (butter oil), urine and dung. The ability of indigenous cow urine is tested for its immunomodulatory properties in mice, rat and avian

lymphocyte cell culture system for the first time and the results are presented in Table 1.

Table 1. Percent increase in immunity through various parameters in comparison to control

Parameters	Percent increase in immunity
1. B-cell blastogenesis	59.5 %
2. T-cell blastogenesis	64.0 %
3. Serum IgG level	19.8 %
4. Serum IgM level	19.0 %
5. Serum IgA level	0.53 %
6. Macrophage Functions	104.0 %
7. DTH reaction	126.0 %
8. Interleukin 1 level	30.9 %
9. Interleukin 2 level	11.0 %

The urine of indigenous cow is also compared with the urine of other animals such as crossbred cows, buffaloes, goats, exotic cows and hill cows. It has been observed that the urine of indigenous and hill cows is quite effective as far as the immunomodulation is concerned the goat urine is also effective but upto the 50% of the cow urine. This finding is further supported by the presence of "Rasayan" in the urine of indigenous cows (Table 2).

Table 2. Analysis urine through chemical fingerprinting (HPLC)

Characteristics	Indigenous cow	Hill cow	Goat	Exotic cow	Cross-bred cow	Buffalo
1. Tridos har (त्रिदोषहर)	√	√	√	√	X	√
2. Madhur ras (मधुर रस)	√	√	√	√	X	X
3. Madhur vipak (मधुर विपाक)	√	√	√	X	X	√
4. Katu ras (कटु रस)	√	√	√	√	X	√
5. Tikta ras (तिक्त रस)	√	√	√	X	√	√
6. Kashay ras (कशाय रस)	√	√	√	√	√	√
7. Raktas shodhak (रक्त शोधक)	√	√	√	√	√	√
8. Deepan (दीपन)	√	√	√	√	√	√
9. Pachan (पाचन)	√	√	√	X	√	√
10. Rasayan (रसायन)	√	√	√	X	X	X
11. Amhar (आमहर)	X	√	√	√	√	√
12. Vat viridhi (वात वृद्धि)	√	√	√	√	X	X
13. Hepatoprotective (जिगर रक्षक)	√	√	√	√	X	√
14. Stress reliever (तनाव रोधक)	√	√	√	√	X	√
15. Effect on blood calcium level (कैल्शियम पर प्रभाव)	√	X	X	√	X	X

## **Strategies to combat with pesticide residues related problems**

### **A. Government level**

1. The farmers should be advised about the harmful effects of pesticides so that they should minimize the use of pesticides in crops. They should judiciously use the pesticide in terms of their quantity and frequency.
2. It should be assured that the pesticides produced in country should be distributed proportionately so that the indiscriminate and impropportionate use can be avoided.
3. All emphasis must be laid on the development of Bio-pesticides like viral, bacterial or fungal pesticides or pesticides of botanical origin like Neem or Tulsi or of cow urine based pesticides, which can be used in crops to kill the insect pests without polluting the environment.
4. The harmful pesticides like some organochlorines, organophosphates and carbamates must be banned strictly in India, their production, import or use should be completely banned.
5. To reduce the effect of pesticide residues, some herbal preparations should be developed which can overcome the immunopathological, neuropathic or nephropathy effects, there are many herbs mentioned in our Indian ancient literature, which can be scientifically validated to prevent and control the harmful effects of pesticides. This will certainly give a new direction to the world not to depend on synthetic things.

### **B. House hold level / Individual level**

1. Avoid the use of chemical pesticides in house such as mosquito repellents, cockroach killers, sprays, mats, coils, etc. All of them are harmful to the body responsible for making body susceptible to various kinds of ailments.
2. Avoid to use synthetic chemicals, dyes, flavouring agents, preservatives, antifungal and antibacterial agents in food items.
3. Use fresh foods as far as possible and after proper cleaning. Vegetables should be kept in lukewarm water with 0.89% salt for at least 30 min before use.
4. Avoid the shining vegetables fruits such as tomatoes, brinjal, lady's finger, apple, etc.
5. Try to have such vegetables/fruits/cereals/pulses which are grown under organic farming.

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