With a view to achieve citrinin control, three categories of substances containing ten varieties each namely medicinal plant extracts, essential oils and homoeopathic drugs were tested against mycelial growth and citrinin production of the test fungus, *Penicillium citrinum* under ‘*in vitro*’ and ‘*in vivo*’ condition. These responses are condensed into the following heads.

**5.1 Medicinal Plant Extracts**

**5.1.1 *In vitro* effects**

For the experimentation 10 medicinal plants viz, *Azadiracta indica*, *Eucalyptus globusa*, *Datura alba*, *Mentha piperta*, *Ocimum sanctum*, *Andographis paniculata*, *Cajan us cajan*, *Azolla*, *Swietenia mahagoni* and *Silybum marianum* at five different concentrations, ie, 3, 5, 10, 20 and 50 mg/ml were employed. On the whole medicinal plant extracts demonstrated dose dependent effects on dry mycelial weight as well as citrinin production.

Cases were recorded where leaf extracts of *Azadiracta indica* and *Eucalyptus globusa* inhibited citrinin production by 72.368% and 63.674% respectively at 50 mg/ml concentration. These results are in agreement with Mossini and Kemmelmeier (2008) who reported massive reduction of citrinin produced by *P. citrinum* in liquid media using neem leaf extract at 6.25 mg/ml concentration despite no effect on mycelial growth. Moderate inhibition in citrinin toxin to the tune of 63.50% and 43.13% could be recorded with extracts of *M. piperta* and *A. paniculata* at 50 mg/ml concentration respectively. Progressively lesser reduction in toxin production was observed as the concentration of the plant extracts went down.

As far as effect on mycelial growth is concerned results were discouraging as none of the medicinal plant extracts were effective in constraining the growth of
*P.citrinum* more than 10% in terms of dry mycelial weight. The research findings reveal inhibition of spore formation in a few cases, ie, *A.indica, C.cajan* and *Azolla*. This observation is also supported by findings of Simone *et al.*, 2009. On the contrary *A.indica* (-1.805%) and *C.cajan* (-2.076%) showed slight enhancement in mycelial growth at 50 mg/ml concentration.

Basically the reason behind the antifungal activity of the medicinal plants is believed to be due to the presence of secondary metabolites which act either individually or in concert (Simone *et al.*, 2009; Parekh *et al.*, 2005 and Joshi *et al.*, 2011).

Author is at loss in tackling the debacle (poor antifungal activity) witnessed as failure in achieving the level of antifungal activity in the present study which could be reasonably accommodated. Reasons are beyond comprehension. Perhaps more plant extracts could be exploited in the study and rigorous evidence fetched at the level of working of secondary metabolite substances, which could not be pursued due to lack of proper lab facilities that my laboratory could offer.

Inhibition of the toxin production as observed in the study does not appear to be simply a function of mycelial weight loss or sporulation reduction. Although sporulation is typically accompanied by mycotoxin production, this is not always true, because mycotoxins may be produced at higher levels under growth conditions where sporulation is inhibited as in the present case of *A.indica*. Studies carried out by Adam and Yu (1998) also support this observation. Medicinal plant extracts do possess fungitoxic as well as anticitrinic property, although their mode of action is not understood very well (Simone *et al.*, 2009). My results show that plant extracts belonging to *A.indica, E.globusa, A.peniculata* and *M.piperta* can be potentially used to reduce citrinin contamination in wheat grains. The use of such plants in folk medicine
also suggests that they represent an economic and safe alternative to treat infectious diseases.

5.1.2 In vivo effects

In order to test the in vivo efficacy of medicinal plant extracts, firstly only five treatments, ie, A.indica, E.globusa, A.peniculata, M.piperta and D.alba that displayed maximum citrinin inhibition in ‘in vitro’ experiment were carried forward in the form of pre and post inoculation treatments on the host, ie, wheat grain. Since no marked variations were recorded, therefore, rest of the treatments were not proceeded for ‘in vivo’ experimentation.

Almost same degree of citrinin inhibition was recorded with A.indica exhibiting maximum inhibition (70.84%) followed by E.globosa (56.90%), A.peniculata (36.06%), M.piperta (34.67%) and D.alba (31.90%).

In post inoculation treatment also maximum toxin inhibition was recorded for A.indica and E.globusa inhibiting toxin upto same extent (36.961%). The activity was observed to be concentration dependent. Plant extracts proved to be much effective when used as preventives rather than curatives.

Till date no solid reason has been reported for the inhibitory effect of medicinal plant extracts. The literature is almost absent documenting the ‘in vivo’ effects of both the treatments on the wheat grain. The in vivo effects of medicinal plant extracts could be attributed to the presence of various secondary metabolites which could not be examined, that act singly or in combination. But the actual reason behind the in vivo effects still needs to be explored.
5.2 ESSENTIAL OILS

5.2.1 In vitro effects

In all 10 essential oils namely clove oil, eucalyptus oil, garlic oil, ginger oil, spearmint oil, citronella oil, sandalwood oil, jasmine oil, lemon oil and amla oil each with 5 different concentrations, ie, 10, 50, 100, 250 and 500 ppm were used. Here also concentration dependent activity was observed.

In case of clove and eucalyptus oil employed at 500 ppm concentration considerable reduction both in citrinin (55.853% and 47.510% respectively) and mycelial growth (38.78% and 35.64% respectively) were recorded. Eucalyptus oil at 250 ppm concentration was moderately inhibitory for citrinin production. Rest of the oils were comparatively less effective in controlling citrinin synthesis. Literature illustrating the inhibition of mycotoxin production other than citrinin by essential oils is endless, but scanty in case of citrinin inhibition. A few examples can be cited; Mossini and Kemmelmeier (2008) revealed inhibition of citrinin production by neem oil. Similarly Vázquez et al., (2001) reported the effect of eugenol (one of the major component of clove oil) and thymol on growth of P.citrinum and citrinin production.

All the test oils exhibited different degrees of antifungal activity against P.citrinum. Only a few oils, ie, clove oil and eucalyptus oil inhibited citrinin upto 38.78% and 35.637% respectively only at higher concentration (500 ppm). These findings are also agreement in with the findings of previous researchers like Serban et al., (2011); Bansod and Rai, (2008); Xing et al., (2011) and many more. The main component of clove oil is eugenol. Eugenia et al., 2009 through their experiments revealed that clove oil and eugenol considerably reduced the quantity of ergosterol, a specific fungal cell membrane component which may be one of the causes of fungal inhibition. It may be possible that the antimicrobial efficacy of the test oils may be due
to above mentioned reason or can be due to other possible reasons like attack on fungal cell membrane disrupting its structure causing leakage and cell death, stopping of the membrane synthesis, inhibition of spore germination, fungal proliferation and cellular respiration (Harris, 2002). Many essential oils are known to exert antimicrobial activity, but the mechanism of action is still not entirely understood (Baydar et al., 2004 and Dewang et al., 2003). The antimicrobial activity of essential oils is assigned to a number of small terpenoids and phenolic compounds (thymol, carvacrol and eugenol) which also in pure form demonstrate high antimicrobial activity. Plant oils are important source of fungitoxic compounds and they may provide a renewable source of useful fungicides that can be utilized as antymycotic drugs. These results also support the notion that plant essential oils play an important role as pharmaceuticals and preservatives.

Until recently, essential oils have been studied mostly from the viewpoint of their flavour and fragrance enriching foods, drinks and other goods. Actually, however, essential oils and their components are gaining increasing interest nowadays because of their relatively safe status, their wide acceptance by consumers, and their exploitation for potential multi-purpose functional use (Ormancey et al., 2001) such as an antimicrobial (Boyle 1955), antiviral (Bishop, 1995), antymycotic (Mari et al., 2003), anti oxidative (Gach-kar et al., 2006 and Yadegarinia et al., 2006), antitoxicogenic (Akgul et al., 1991 and Juglal et al., 2002), antiparasitic (Pandey et al., 2000 and Pessoa et al., 2002) and insecticidal (Karpouhtsis et al., 1998) agents. Despite rich literature documenting antimicrobial and antitoxicogenic efficacy of essential oils, the antimicrobial molecules present in essential oils and their eventual interactions still need to be addressed.
5.2.2 *In vivo* effects

Same pattern of experimentation was followed as in case of medicinal plant extracts. Only clove oil, eucalyptus oil, spearmint oil, zinger oil and amla oil were carried forward for their *in vivo* achievement.

In case of pre inoculation treatment maximum inhibition was obtained with clove oil (40.77%). Rest of the oils inhibited citrinin below the considerable limit.

These oils in case of post inoculation treatment were not at all satisfactory. None of them even managed to achieve the considerable limit of toxin inhibition. Here also dose dependent responses were observed. Literature is rich in documenting the *in vivo* potential of essential oils with regard to toxins other than citrinin. The reason behind *in vivo* effects may be due to the presence of various phenolic compounds present in different ratios in oils. But the actual reason still needs to be explored.

Comparison of the data obtained in the study with that of the previously published results already mentioned above is problematic. Firstly, the composition of plant oils and extracts varies according to local climatic and environmental conditions. Secondly, some oils with the same common traditional medicine may be derived from different plant species (Janssen *et al*., 1987 and Sivropoulou *et al*., 1995). Thirdly, the method used to assess antimicrobial activity and the choice of test organism also varies (Reynolds, 1996). Therefore, it is quite obvious that the results may differ.

5.3 Homoeopathic Drugs

5.3.1 *In vitro* effects

To achieve citrinin control, 10 homoeodrugs, namely, Arnica montana, Arsenicum album, Belladona, Drosera rotundifolia, Iodium, Natrum phosphoricum, Opium, Sulphur, Spongia tosta and Thuja occidentalis in potencies 3, 6, 12, 30 and 200 were used.
Unlike medicinal plant extracts and essential oils inharmonious effects were recorded in case of dry mycelial weight as well as in citrinin inhibition with homoeodrugs. The effects displayed by homoeodrugs on citrinin production are totally unusual, they have no co-relation with the effect on mycelial growth of *P. citrinum*.

Cases were recorded where some of the homoeodrugs like Arsenicum album 30, Iodium 6 and Thuja occidentalis 6 were able to curtail both citrinin production and growth. These were considerably fungitoxic that reduced the fungal growth as well as citrinin production to the extent of 35-50% and 40-60% respectively. Moreover, none of the drugs used inhibited fungal growth of *P. citrinum* upto more than 50%.

Distinctly, some of the drug potencies suppressed citrinin production alone. These were Arnica montana 30, Drosera rotundifolia 200, Opium 6 and Sulphur 3, 30. All these drugs inhibited citrinin upto more than 50%. On the other hand these drugs were barely effective on mycelial growth.

Next, there were some drug potencies like Arnica montana 3, 6; Iodium 6, Natrum phos 30 and Thuja occidentalis 3 that moderately checked the fungal growth ranging from 35-50% without inhibiting citrinin production.

Moreover, there were lot of cases where drugs were observed as poor fungitoxicants inhibiting mycelial growth less than 20%. Some examples are Arnica montana 30, Arsenicum album 3, Belladona 6 and Iodium 12, 30.

Surprisingly none of the homoeodrugs used in the study achieved cent percent inhibition neither in citrinin production nor in fungal growth. Likewise, stimulation in both cases remained ellusive.

As far as inhibition of mycelial growth of *P. citrinum* by homoeodrugs is concerned, surprisingly literature is totally lacking. Those who have used

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*Control of Penicillium toxin by unconventional substances*
homoeopathic drugs, have used it against other fungi such as *Aternaria solani, Botryodiplodia theobromae* and *Rhizopus nodosus* (Dua and Atri 1986), *Colletotrichum* and *Fusarium* (Khare and Atri 1996) and *A. flavus* (Shrivastava and Atri, 1998).

The patterns of the results shown by the homoeodrugs on citrinin production are very well supported by other researchers but on other mycotoxins like, Shrivastava and Atri (1998) and Shabnam Bee and Atri (2012).

Homoeopathic drugs were reported to induce effects pertaining to citrinin production, “in vitro” and “in vivo” and mycelial growth of *P. citrinum* that had no interdependence, whatsoever, among these components.

### 5.3.2 *In vivo* effects

Unlike the dose dependent effects achieved in case of plant extracts and essential oils, homoeodrugs displayed sinusoidal (dose independent) effects under *in vitro* conditions. Therefore, all the 10 homoeodrugs were employed for testing their pre and post inoculation treatments to assess their curative and preventive potentials in controlling the citrinin production.

In case of pre inoculation treatments the effectiveness of several drugs like *Arsenicum album* 6, 12; *Belladona* 30, 200; *Drosera rotundifolia* 6, 30; *Iodium* 30, 200; *Natrum phos* 30, 200; *Opium* 30, 200; *Sulphur* 200, *Spongia tosta* 12, 200 and *Thuja occidentalis* 12, 30, 200 were raised to more than 20% in inhibiting citrinin synthesis (Table-20) in comparison to their *in vitro* achievements (Table-16)). Reversely, a few drugs like *Arnica Montana* 12, *Arsenicum album* 30, *Drosera rotundifolia* 200, *Iodium* 6, *Opium* 6 and *Sulphur* 3 were more effective *in vitro* conditions. Some of the drugs like *Belladona* 6, *Sulphur* 30 and *Thuja occidentalis* 3, 6 exhibited almost similar degree of toxin inhibition both in *in vitro* and *in vivo* conditions.
On comparing the post inoculation treatments with the *in vitro* effects certain drugs like Arnica montana 12, 200; Arsenicum album 3, 6, 12, 200; Belladona 12, 30; Drosera rotundifolia 3, 30; Iodium 30, 200; Natrum phos 6, 12, 200; Opium 6, 30, 200; Sulphur 200, Spongia tosta 6, 200 and Thuja occidentalis 30 revealed noticeable increase in citrinin inhibition (more than 20% increase). On the contrary some of the drugs like Arnica montana 6, 30; Arsenicum album 30, Balladona 6, Drosera rotundifolia 200, Iodium 3, 6; Sulphur 3, 12 and Thuja occidentalis 3, 6, 12, 200 showed better profile inhibition under *in vitro* condition than in *in vivo*. Remaining drug potencies of homoeodrugs showed almost similar pattern of inhibition under both conditions.

When pre and post inoculation treatments were compared most of the drugs like Arsenicum album 6, Belladona 3, 30, 200; Drosera 3, 30, 200; Iodium 200, Natrum phos 12, 30; Opium 3, 12, 200; Sulphur 6, Spongia tosta 12, 30 and Thuja occidentalis 3, 6, 200 proved to be better anticitrinic agents when used as preventives. Oppositely, a few of the drugs like Arnica montana 12, 200; Arsenicum album 12, 30, 200; Belladona 12, Iodium 6, 30; Natrum phos 6, 200; Opium 6, 30; Sulphur 12, 30, 200; Spongia tosta 3, 6, 200 and Thuja occidentalis 30 appeared better as curatives. Remaining drug potencies showed almost parallel effects both in post and pre inoculation treatments. Based on the results obtained, conclusion can be drawn that pre inoculation treatments of the wheat grain with homoeodrugs were far better than post inoculation treatments.

Thus, we observed several deviations from the expected results. It is also evident that the mycelial inhibition may or may not suppress citrinin production. The drug responses are also altered under *in vivo* conditions. No literature is available as yet that could reveal the mechanism behind the homoeodrugs activity. It is quite possible that homoeopathic drugs might have acted at different stages of metabolic pathway of
citrinin production through activation or deactivation of certain key enzyme or certain reactive intermediates that ultimately lead to citrinin production. The efficacy of homoeodrugs varies from drug to drug and potency to potency. We do not know from the available literature which could suggest the working of homoeodrugs action in relation to citrinin synthesizing attributes of fungal organisms.

**Special features of observation of homoeodrugs action**

In order to suggest a suitable measure for controlling citrinin contamination in wheat grain caused by *P. citrinum*, homoeopathic drugs were used as substitute to the conventional counterparts. The reason behind employing these alternatives used in plant protection, is that they are safe, non mutagenic, non carcinogenic, ecofriendly and cheap. Besides they affect biological processes without producing toxicity.

During the tenure of research, effect of homoeo-substances were analysed in terms of citrinin production by the test fungus under *in vitro* and *in vivo* conditions. The data so obtained does not ensure any correlation between drug potencies and their corresponding responses. The behaviour of drugs was totally opposite to that of the conventional substances. Drugs that appeared as promising fungitoxic agents checking the mould growth failed to control citrinin production. Likewise, drugs that were poor as fungitoxicants brought about brilliant reduction in toxin production. Similar differences in responses were also recorded under *in vitro* and *in vivo* conditions both in terms of curative and preventive potentials. Furthermore, different drug potencies did not elicit responses in proportion to their concentrations behaving as if they were different drugs and not different doses of the same drug. The thesis is replete with such examples, extremely baffling to negotiate with in orthodox manner. These perplexities could be comprehended, at least in part, if one is conversant with the mystique of homoeopathic substances, which are class aside from their mainstream counterparts.
In this regard, the author would like to undertake at discussing some of the spectacular features of observation noticed during the course of present investigation.

Among 10 homoeodrugs used in 3, 6, 12, 30 and 200 potencies, some of them emerged as fairly good fungicides, though none of them achieved cent percent inhibition. The observation is not unique and new. Such observations are also reported by previous researchers dealing with homoeopathic drugs (Singh and Gupta, 1981; Dua and Atri, 1983; Khare and Atri, 1994). This is contrary to conventional substances. The reason for this lack of complete inhibition is still not known. A few reasons could be advanced.

(1) It could be due to the fact that limited number of drug potencies were used, whereas more should have been employed to achieve the expected outcome.

(2) Another reason could be that drugs employed in the study belonged to materia medica developed for treating human sufferings. In fact materia medica for treating plant sufferings has not been developed. There is an urgent need to develop such a medica using many host-pathogen-drug systems and record data on all parameters to develop a parallel material medica for the treatment of various plant ailments following a tedious procedure of drug proving (Khurana and Gupta, 1982). This kind of work is presently at an incipient stage only (Dutta, 1994). However, drugs were randomly selected from the materia medica used for treating human sufferings, though whatever drugs were used they might have presumably acted homoeopathically.

(3) Another striking feature for homoeodrugs' performing relatively better under in vivo condition may be due to the reason that the homoeodrugs consider host as main site of action, as the fundamental contradictions of health and disease function optimally at host level. Drugs mobilise the power to defend against the
pathogen via host, pathogen being the outer agency acting as the second fiddle. That is why *in vitro* performances of homoeodrugs were found to be transformed under *in vivo* conditions. More or less similar views have been shared by Khare and Atri (1983); Shrivastava and Atri (1998); Bee and Atri (2012). This discriminates homoeopathy from the modern medicine that accounts the pathogen to be the prime mover of the disease.

(4) Another feature that comes forth perspicuously during the study is that, drugs in general displayed multiple optima over an array of potencies depicting marked activity in their accomplishments across phenomena of mould growth and citrinin synthesis both under *in vivo* and *in vitro* conditions. This can be illustrated with any homoeodrug. Take for example Arsenicum album. Growth responses of *P. citrinum* vacillate quite a lot over a range of its potencies, e.g., 6.02% at 3, 29.53% at 6, 34.56% at 12, 46.74% 30, 23.19% at 200. Same trend is followed by citrinin production. 9.35% inhibition at 3, 11.54% at 6, 29.72% at 12, 51.12% at 30 and 29.08% at 200. Same course continued under *in vivo* condition also.

These vivid responses that came across in the present study are also witnessed by early researchers too (Khare and Atri, 1995; Shrivastava and Atri, 1998). These seem to be consistent with the observations made by Toledo *et al.*, (2009) who evaluated the effect of Sulphur and Ferrum sulphuricum in varying potencies to control the early blight of tomato plants. Similar observation was also reported by Bonato *et al.*, (2006, 2007) who checked the effect of Lachesis and isotherapics of virus SCMV (*Virus*) in different potencies on sorghum plants and found improvement in the general condition of the plant.

Such broad variations in responses observed in case of homoeopathic drugs were not observed either with medicinal plant extracts or essential oils used in the
present study. Conventional substances exceptionally present such phenomena (Montgomery and Shaw, 1963). For example Dimond et al., (1941) found two peaks for the fungicide TMTD (tetramethyl thiurum disulphate) and matched these peaks with their different physical states, one with the ionised form and the other with its unionised form. Similar phenomenon was also reported by Horsfall (1956) who suspected that different states of existence of substances might be responsible for different peaks vis a vis different styles of actions. Same could be genuine for all substances demonstrating such effects. But for homoeopathic substances this stands out to be rather a rule. It could, therefore, be legitimately deduced that homoeopathic drugs act at multiple sites corresponding to their multiple optima. The prospect of evolving resistance to such multisite toxicants, by following alternative tracts would rather be staggeringly low as opposed to site specific toxicants which are thereby more vulnerable (Dekker, 1976; Ziv and Hagiladi, 1993). This could be the reason for the evolution of resistance in many pathogens towards benomyls compared to dithiocarbamates (Owens, 1969 and Geogropouls, 1977). Therefore, homoeodrugs could be supposed to be more suitable as chemotherapeutic options.

A few Indian workers like Khurana, 1968, 1980; Khanna and Chandra, 1976b, 1977; Khare and Atri, 1995; Shrivastava and Atri, 1998; Bee and Atri, 2012; Khuda-Bukhsh, 2011 have also recognised the multiple site concept as the basis of homoeopathic drug action. This is also being recognised by Kolisko, 1959 who tried a range of dilutions of antimony trioxide, copper salts and iron sulphate on the germination of several seeds including wheat and found out that seed germination and plant growth were promoted by lower dilutions, then slowed down by higher dilutions and then enhanced again by still higher dilutions.
Similar trend was, likewise, recorded by Pelican and Unger (1971) with regard to wheat growth using microdoses of silver nitrate in different decimal potencies. Such sinusoidal effects of homoeodrug action have also being recorded on various microbial, plant and animal systems (Wannamaker, 1966, 1968; Stephenson, 1955; Coulter, 1982). Conventional substances refuse to obey the sinusoidal drug responses and routinely follow the monotonicity principle.

What accounts for this typical action of homoeodrugs? The mystery most believably lies in the mode of drug preparation. In homoeopathy different drug concentrations are prepared by a process using not only dilution but also succussion (potentization) (Hahnemann, 1921), the former affecting the amount and latter the form of the drug, each form gifted with a distinct therapeutic property.

Another unique feature, probably the most striking one is the one related to the paradox presented by homoeodrugs themselves. Homoeodrugs are believed to contain no drug substance beyond 12th potency (10^{-24} dilution) as no substance can exist crossing the theoretical limit imposed by Avogadro’s number (6.03x10^{23} atoms/mole). Drugs employed in present study belonged to potencies 3, 6, 12, 30 and 200. Homoeopathic remedies are usually diluted to the point where there are no molecules from the original solution left in a dose of the final remedy (Milgrom, 2007). Thus, it is highly likely that any of the original drug molecule remains beyond 12 (Kayne, 2006). But drugs, curiously enough, were found to have acted. How come? This is on the dot the point of criticism invoked by scientific community including the practitioners of modern medicine against homoeopathy. Therefore, claims of homoeopathy curing a number of incurable diseases and disorders are not taken seriously and discarded as a placebo therapy,
Despite persuasive evidence and experiences buttressed by the use of homoeopathy over the last 200 years (Lee and Thompson, 2007b; Wahlberg, 2007; Nuhn et al., 2010). On the other hand Dr. Montagnier, the French Virologist, who won noble prize in 2008 for discovering AIDS virus strongly supports homoeopathy and in his opinion high dilutions are right. High dilutions of something are not nothing. He says that homoeopathy is not pseudoscience, it is not quackery, it is real phenomenon which deserves further study. Benveniste (1988) and Brian Josephson, both Nobel laureate are also of the same opinion. It is a shame on orthodoxy that such kind of work is overlooked and even demonized.

However, situation is not so gloomy now. Thanks to the developments in molecular chemistry and advanced probes, that some insight into the physical nature of homoeopathic drugs can be gained. A number of credible arguments based on experimental findings have been forwarded to explain mystery of paradox posed by homoeodrugs (Gibson, 1968; Burnard, 1974; Rawsom, 1976; Koley, 1978). Among these, a few are attracting recognition from the scientific community also. One of the upcoming hypothesis is that during the process of potentization drugs’ properties are relegated to the solvent (water/alcohol). During the course of potentization solvent molecules begin to take up novel orientations and after 12th potency when the drug molecules have “disappeared”, such orientations continue to exist, their magnitude and configurations changing according to the degree of potentization. Thus, solvent molecules themselves achieve the essential therapeutic properties of the drug and hence their action on the biological systems (Bockries and Reddy, 1973; Kumar and Jussal, 1981; Allegre et al., 1989; Anaganostatos et al., 1998; Bellavite and Signorini, 2002; Kayne, 2006). Bernard and Stephenson (1967), Smith and Boricke (1974).
Luu, (1976), Sharma (1982) and Montagnier (2010) are of the same opinion. Montagnier’s work focuses on a new scientific movement at the crossroad of physics, biology and medicine. His research claims that electromagnetic waves emanate from the highly diluted DNA of various pathogens, produces structural changes in water which persist at very high dilutions and which leads to resonant electromagnetic signals that can be measured. He further affirms that these new observations will lead to novel treatment for many diseases. Modern advocates of homoeopathic remedies attribute their effects not to water molecules but to modifications of the water’s structure and that during mixing and succussion the substance leaves an enduring effect on patient (Maddox et al., 1988; Grimes, 2012).

The hypothesis is gaining some experimental support. Smith and Boricke (1974) using NMR studies demonstrated significant difference in spectra of the hydroxyl groups of the dynamized dilutions of sulphur when compared to alcoholic control. Laser Raman spectrometric observations of Boiron and Vinh (1976) have shown that at higher potencies of potassium bichromate, the spectrum of alcohol disappears almost completely whereas that of potassium bichromate appears. This demonstrates clearly that alcohol molecules themselves have changed to produce the LR spectrum of potassium bichromate. New researches conducted at the respected Indian Institutes of Technology have confirmed the presence “nanoparticles” of the starting material even at extremely high dilutions (Chikramane, 2010). Researchers have demonstrated by TEM, electron diffraction and chemical analysis by inductively coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) the presence of physical entities in extreme
dilutions. Researches received confirmation of the nanoparticle existence at two different homoeopathic high potencies, 30C and 200C and because they tested four different medicines (Zineum mat, Aurum mat, Shannum mat and Cuprum mat), the researchers concluded that these study provide “concrete evidence”.

Two times winner of Nobel prize in chemistry, Benveniste (1988) described that basophils released histamine when exposed to homoeopathic dilution of anti immunoglobulin E antibody. The research was replicated in four different laboratories also but ignored by the advocates of allopathy. The concept of dynamization inducing the diluent medium to mimic the properties of the original drug substances is being favoured by many scientists including Young (1975), Sharma (1982), Maddox et al., (1988), Montagnier (2010), Grimes (2012). But the medical claims of homoeopathy are unsupported by the combined weight of the modern scientific research (Ernst, 2002). The proposed rationale for these extreme dilutions, that the water contains the “memory” of the diluted ingredient is counter to the laws of physics and chemistry (Teixeira, 2007; Grimes, 2012). It necessitates, therefore, that the laws of physics and chemistry be reviewed and extended in the light of the tenets of homoeopathy. Misinformation and misstatements on homoeopathy are predictable because this system of medicine provides a viable and significant threat to economic interests in medicine. It is, therefore, not surprising that the British Medical Association had the sheer audacity to refer homoeopathy as “witchcraft”.

(7) Another advantage bestowed by homoeopathic drugs is that they find it easier to cross the cell membranes as they are composed of dynamized water or alcohol molecules, whereas mainstream substances which are used in macrodoses find it arduous to cross the cell membranes (Sharma, 1982).