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A novel phenomenological model for unusual behavior of high dilution molecular mixture applicable in diluted homeopathic medicine

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Abstract

Physicochemical behavior of high dilution mixture as in Homeopathic medicine (hereafter Homed) is very complicated. In the present paper, we introduced the concept of creation of hydrogen bonded "active ion/molecule" (termed as NAM) or nano-cluster (earlier observed in water-alcohol mixture) carrying the signature of the disease curing cues. These NAMs, dipolar in nature, are created during the "succussion" process (potentization) preparing a Homed. The different NAMs are capped by the different cues from the medicine molecules used to produce Homed. The nano-structural NAMs are finally stabilized in the host liquid/solid media. Therefore, in the healing process by a Homed, presence/absence of original solid or liquid medicinal molecules in the host is not that important. Only the NAMs formed in the host medium take part to cure the disease. The numbers of such NAMs decrease with increasing dilution, but their activity and dynamicity increase, thereby increasing the potency of the higher diluted Homeds. This novel conjecture of the formation of H-bonded nano clusters is supported by previous experimental studies carried out with water-alcohol mixtures, in particular.

Keywords: Homeopathy, potentization, active ions, alcohol-water mixture, potency, molecular interactions, higher dilution

Introduction

The physics and chemistry of high dilution binary or ternary mixtures are very complicated and several theoretical and experimental studies had already been carried out to understand the puzzling behavior of such mixtures^[1,7]. In preparing high diluted Homeopathic medicine (Homed), used dilution process, (also known as "dynamisation" or "potentisation") is a process in which a small amount of the solute or a liquid medicinal substance is diluted within a large amount of alcohol or distilled water medium. The mixture is vigorously shaken in a process called "succussion" which appears to be equivalent to rigorous mechanical agitation used to produce nano-particles of solid materials^[8]. It is well known that this process is very essential and without adopting such a dynamization process, Homed cannot acquire the healing power or activity (potency). Ultimately different higher potency mixtures are produced. However, Homed used by homeopaths are mostly diluted to that extent where they could contain no molecules of the original substance. According to the founder Father of homeopathy, Samuel Hahnemann (1755–1843), the process of succession activates the "vital energy" of the diluted substance, and that successive dilutions increase the "potency" of the preparation. However, the answers to the questions why and how it happens have not been elucidated so far^[9, 10]. This is because, at such a low dilution, no molecule or nano-particles of the original medicinal material is likely to be present. Moreover, it has not yet been experimentally confirmed. But metallic or solid nano-particles from the wall of the container which might be present in the diluted medicine are not considered to be active for curing a disease. So, how diluted Homed does work (or cure diseases) is a big question. Furthermore, a more dilute Homed shows a higher potency, and also considered to be stronger and deeper-acting. The end product is often so dilute that it is indistinguishable from the host diluents (pure water, sugar or alcohol) as already mentioned. Therefore, in more diluted Homed, the activity of the medicine is difficult to explain. Questions also arise regarding different curing capabilities of the Homed. It is also noticed that sometimes a Homed cures a disease very quick and in some other cases, the curing process is so slowly that it is difficult to keep faith in Homed. There are no persuasive explanations of all such queries related to the curing process of any typical high diluted

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Homed (i.e. there is no scientific explanation of “why and how a Homed works in human body”). The present scenario is such that Homed is used by those who have faith in it, and those that sell it.

Hahnemann believed that the dynamization or shaking of the solution used for preparing Homed caused a "spirit-like" healing force to be released from within the substance. Even though the Homed are often extremely diluted, homeopaths consider the existence of a healing force in these homeopathic preparations. Supporters of homeopathy have also proposed another concept of “Water Memory”, according to which water "remembers" the substances mixed in it, and transmits the effects of those substances when consumed [11]. This concept is inconsistent with the current understanding of matter, and water memory has never been demonstrated to have any detectable biological or other effect. The actual memory of water or other liquid was measured experimentally and was found to be around 10^{-14} - 10^{-15} seconds. Many materials have almost such memory or better. Therefore, the claim of "water memory" cannot be supported experimentally. Some scientists There are some experimental supports for the idea that ultra-molecular Homed might possess unique physical properties and can exert unique physiological effects. A systematic review was published research on homeopathic dilutions [12]. One of the leading current proposals for how ultra-

molecular diluted Homed work is that water is capable of storing information relating to substances with which it has previously been in contact [13]. In 2003 Swiss chemist Louis Rey [14] claimed from the thermo luminescence measurement that homeopathically diluted solutions of sodium chloride and Lithium chloride have a very different hydrogen bond structure from that found in normal water. NaCl and LiCl have differently modified the hydrogen bond of water and hence the H-bonded NAP nano-structure, referred above. Rey claimed that even though they should be identical, the structure of hydrogen bonds in pure water is very different from those in homeopathic dilutions of salt solutions formed by rigorous succussion. This is a very important prediction from the said thermo luminescence measurements. These modified hydrogen bonds actually carry the healing power of different diseases and they form dynamic clusters which might also be electrically charged because of the presence of H-bonds with spin states (+1/2) and (- 1/2). These hydrogen bonds can orient, move or order like spins (or like dynamic “strings”, a particle of modern discovery [15]). Such “spin” or pseudo-spins (as mentioned above) can be associated with the ordering H-bonds. [16] In NAMs. Such a two level H-bonded system (considering two possible orientation of the pseudo-spin associated with the H-bonds) can be described by a transverse Ising type model. [16]

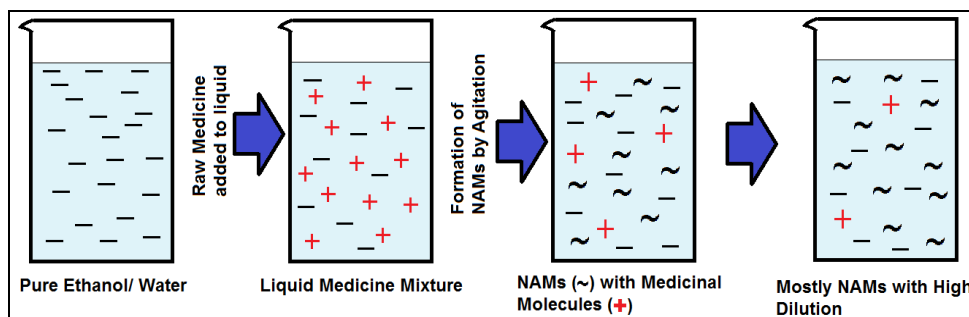


Fig 1: Schematic representation of liquid medicine mixture and the formation of H-bonded nano cluster or NAMs (~ signs) in the mixture due to potentiation (mechanical shaking)

Our plan is to provide a phenomenological explanation of the above mentioned quarries considering the concept of the formation small hydrogen bonded molecular clusters during "potentization" of the medicine in the host alcohol/water mixture. Potentiating causes the formation of some novel hydrogen bonded dynamic “active ions/molecules” (NAMs shown by ~ signs in Figure -1. The NAMs are H-bonded rings or nano-clusters (Figures 2a and 2b) elaborately discussed in [10, 17]) produced in the host liquid (water-alcohol mixture, say) as visualized from the previous

structural [10] and the luminescence and other spectroscopic measurements [3, 14]. During “dynamization” or "potentization" process NAMs are form and different medicinal molecules only transmit different therapeutic physicochemical information to such active ions (NAMs) which take part in the healing mechanism of a typical Homed curing a particular disease. The interactions among the medicinal molecules, the host liquids and the walls help to the formation of such characteristic active ions but

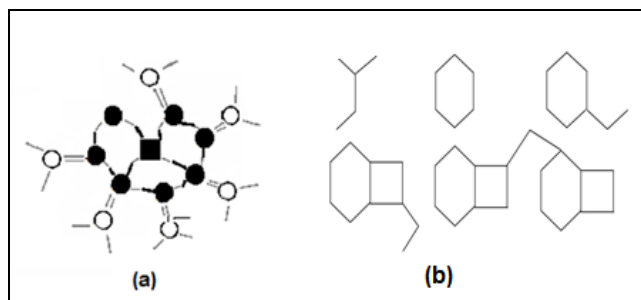


Fig 2: Schematic representation of ring structure formed in the ethanol–water mixtures. H-bonded ring structures might be closed or open (a and b) in structure as observed from different experimental theoretical observations [10, 17]. Actually water- alcohol molecular interaction gives rise to new ordered structures where water molecules might bridge methanol chains to form ring structures [10, 17].

Neither the medicinal molecules nor the host molecules take part in the potency of a typical Homed curing a typical disease.

Present proposed model for explanation of the potency of high diluted Homed

It is to be noted that water in alcohol produces a unique mixture [1, 7, 10, 14, 17, 18] (one may call the mixture itself a kind of Homed, where alcohol is the host and water is the added medicine). Unfortunately, during the last 50 years, though many researches were carried out, no satisfactory answer to the molecular structure of these two liquid mixtures has been put forwarded which might be due to very dynamic character of the modified hydrogen bond structures in this mixture. Recent advance spectroscopic and structural studies^[14] revealed that the structure of liquid methanol (or

ethanol) at room temperature is a combination of h-bonded ring/clusters, each made up of 6, 8, or more methanol/ethanol molecules [10, 14, 17] (see the schematic figures-2) The ring structures (Figure 2), present in the water alcohol mixture was elaborately discussed by Gereben¹⁷. We consider that such rings (open or closed)/clusters acquire the characteristic features of the medicine during rigorous agitations generated in the liquid mixture while preparing the Homed. It had been shown earlier by Rey [14] that the structure of hydrogen bonds in pure water is also very different from that in homeopathic dilutions of salt solutions. Similarly, structures of pure alcohol and pure water are quite different from those in their diluted Homed mixture forming a Homed because of the formation of NAMs.

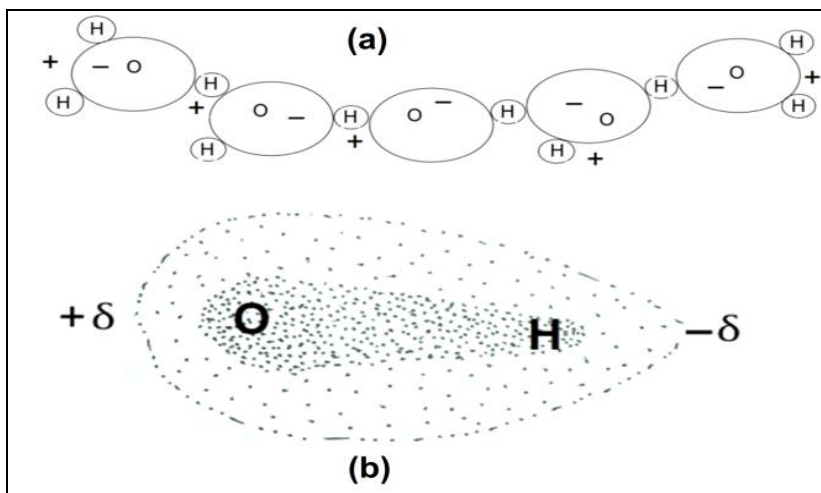


Fig 3: Dipolar bonding in the NAM clusters. The pseudo-spins are considered to be associated with the H-bonds which are shared by the water and alcohol molecules forming rings as shown in Figure 3a. The distribution of electrons around oxygen and hydrogen are asymmetric (Fig.3b) as oxygen is more electronegative than hydrogen which causes dipole moments of the NAMs. Even though the total charge on a NAM cluster is zero, the nature of chemical bonds is such that the +ve and -ve charges do not completely neutralize in a NAM cluster and hence NAM becomes little polar possessing a permanent dipole moment. The mechanical process of potentiating of a Homed causes little polarization of such dipole moments. The dipolar interaction between the water molecules and the NAMs represent a large amount of internal energy which causes large specific heat of the NAMs which they use to cure the diseased cells. The polar nature of water molecules allows them to bond to the NAMs and associate high surface tension of water keeps the dynamic NAMs stable although their H-bonding arrangement might change.

The cluster (NAMs) size distributions can be calculated [19] from the probability functions:

$$S_n = \sum_K s(n,k) / \sum_{k,j} s(j,k)$$

Where s_n is the probability for the cluster formed of n sites, $s(k,n)$ represents the number of clusters of the size n in the configuration k . It should be noted that pure water does not produce any specific clusters. [21, 22]. However, pure ethanol contains specific clusters in the form of chains and loops, much like methanol [21, 22]. There is a major difference in cluster behaviour in ethanol-water mixture. These clusters /rings are get modified by shaking with medicinal molecules which we call NAMs. The H-bonded NAMs are dipolar in character. A schematic representation of electron distribution around oxygen and hydrogen is shown in Figure -3b.

The H-bonds associate with such closed ring/cluster like structures carry the signature of the medicinal molecules (let us call it distorted micro rings or clusters) and different nano clusters might have different structures and dipole moments

with different hydrogen bond orientations. For example, when a minute amount of solute (say NaCl) is mixed with alcohol/water such distorted clusters or open chain like structures (Figure 3) appear with rigorous shaking or agitations. These H-bonded chains or clusters remain embedded in the mixture as an individual entity moving like free dipoles which we termed as “activated molecules” or “activated ions” (NAMs, Figure 2), as mentioned earlier. These active H-bonded NAMs, are stable and ever dynamic [20] in character in the liquid (alcohol/water) or in other host. This conjecture was supported by the above mentioned thermo luminescence, structural and other studies^{[18-26][22-25]}. The character of a NAM might be compared with electron spin or pseudo-spin having spin quantum number ($\pm 1/2$) for two levels system associated with the H-bonds constituting the dipolar NAMs. Such spin or pseudo-spin concept was also used to explain ferromagnetic and ferroelectric phenomena [16]. Such pseudo-spins follow the equivalent spin dynamics (ordering and disordering) of magnetic or ferroelectric ordering/disordering and explaining the true magnetic or ferroelectric phenomena. One may ascribe such pseudo-spin associated with different

orientation of the H-bonds in each NAM and also describe their polarization, just like spin polarization in a particular orientation and pseudo-spin popularization in nonmagnetic H-bonded ferroelectric [16]. For better therapeutic activity, the pseudo-spins associated with the H-bonds in the NAM must be aligned (polarized in a direction). This alignment is more probable with higher dilution (where the NAM numbers are relatively becomes smaller) where their energy increase with dilution). Potency of the Homed increases with increase with the increase of pseudo-spin alignments. Because of lesser number of NAM in the higher dilution Homed, NAM-NAM and NAM-wall interactions are less. Such interactions change the orientation of the H bonds in the NAMs along with their energy and entropy. In lower dilution, numbers of such NAMs are more with lower energy and there is strong self-interaction which lowers their dynamicity and potential. However, in increasing dilutions and agitations, their numbers become gradually reduced but their energies increase and they become more dynamic (with more energy and entropy as they have more available space and undergo lesser number of interactions with the neighboring NAM and the wall) with high potential to cure the disease (interact with the diseased atoms/ions). So healing power of the medicine increases with dilution where lesser numbers of highly dynamic NAMs are present. Again, in the process of clustering or NAM formation, the oxygen in one water molecule might be attracted to the hydrogen in the hydroxyl group in a nearby alcohol molecule, and vice-versa (Figure.2b). While forming these bonds with alcohol, enthalpy changes due to agitation with release of energy. As in the case of a living cell, entropy of the NAMs in the Homed is dynamic in character (space, time dependent and temperature). Because of this dynamic dipolar character associated H-bonds, NAMs can interact with the living body cells and the cell-cell communication takes place.

Potentiating with different dilutions of the medicine is only associated with the dynamicity or entropy changes of the NAMs (due to different degrees of disorder/distortion produced in the molecules forming NAM structure depending on the degree of potentiating, temperature and the process used). These potentized dynamic NAMs, whose number in the medicine mixture varies depending on dilution, shaking time, solute concentration and solvent character, carry the healing information and entropy generated in the process of dilution of the medicine. This is similar to the previous reports suggesting that the silver nano-particles synthesized using different medicinal plant extracts were capped by the organic components present in the different plant extracts [27, 28]. The physicochemical properties of the same Ag nano-particles produced from different extracts are different. This suggests that any other molecule coming in contact with the alcohol/ water mixture (say) induces some typical characteristic properties of the molecule to the hydrogen bonded NAMs formed in the alcohol /water (to the said rings or clusters).

Until such dynamic NAMs carrying healing information induced by the medicinal molecules are formed in the mixture, healing power of Homed is not developed or the Homed is inactive to cure a disease. This means, a simple mixture of water/alcohol or the solid medicine without rigorous shaking does not contain such active NAMs with healing power and it is not a Homed at all.

Discussion

(a) Different character of different NAMs similar to the dynamic stem cells

The dynamic NAMs have different physicochemical properties depending on the structure and character of the solute medicine used to produce them by intense shaking and they acquire the typical healing capability of a particular diseased cells (similar to the behavior of the stem cells [29] curing/repairing different diseased cells in presence of suitable media) when the diseased cells come in contact with NAMs. That is, each oriented (polar) NAM appears to be equivalent to a stem cell and both function similarly to cure the diseased cells. The stable NAMs once formed, can carry typical cues (healing power and potency) of the medicine (forming them) for a long time and communicate healing information to the body cells (or other suitable media). The healing information is transmitted to the brain (via neurons/or other chemical reaction). The brain keeps track of the diseased cells in the body and signals the NAM to interact with the diseased cell to cure the diseased cells by bringing it in equilibrium in energy (entropy, information, temperature and pH around ~7.4~). It is to be noted that temperature and entropy of the live diseased cell is higher compared with those of normal ones. The process is like communication between living cells (cell signaling process in biological science [30]). The process, as mentioned above, might also be comparable to the process of remediation of diseased cell/organs by the stem cells. Here lies the unified mechanism of curing by Homed, Allopathic or other kinds of medicines.

(b) Functions of entropy and information behind functioning of Homed

In biological system, there is strong correlation among entropy (S), information (I) theory [31] and cell signaling process [30]. It had already been established that information (Shannon theory of information and entropy are equivalent and interdependent (one increase with the decrease of the other [32]). This is similar to the case of equivalence of mass (M) and energy (E) from the relation $E=Mc^2$, where c is the velocity of light $\sim 3 \times 10^{10}$ cm/sec (according to Einstein's mass-energy relation). A minimum unit of information may be called a bit of information carried by the H-bonded NAM cluster/molecule and this information in entropy unit is equal to $\sim k_B \ln 2$ or $\sim 1.3 \times 10^{-16}$ erg/K (where K is degree Kelvin, body temperature ~ 300 K and k_B is the Boltzmann constant) which is very small energy (or information) transferred from the NAM (as medicine) to cure a diseased cell. This means, the minimum energy an active ion (NAM), in diluted solution, carrying the healing information (in unit of bit) is equivalent to $\sim 1.3 \times 10^{-16}$ erg/K unit. If a NAM carry more energy in multiple of bits (in case of higher dilution) then the NAMs have higher degrees of freedom and it becomes more active (with longer mean free path and higher velocity) with increased entropy content. This information or energy/K carried by the NAM molecule is transferred (like cell signaling or cell-cell communication process [33] as mentioned above) to the brain (through neurons and electrochemical reaction) and the brain sends the necessary information to cure the diseased cell (having different proteins with capabilities of receiving the information which acts as medicine). Modern biology also explains the cell to cell signaling/communication process by communication theory [30-33] which in turn related to the

entropy acquired by the cells. It is to be noted that different small molecular weight chemicals are secreted by the cells while cell to cell commutation/signal takes place. The entropy change during cell-cell communication is associated with these secreted small molecular weight chemicals.

(c) Different NAMs and different Homeds

Different therapeutic medicines produce different types of H-bonded NAM nano-structures of different H-bond distortion (or orientations) in the NAM clusters. For example, in Bryonia 30 (say), the character (entropy, energy and information content) of the NAM H-bonded units are quite different from those of the NAMs produced by Beladonna 30 (say) within the same liquid medium (alcohol/water) using the same process. That is, the character and properties of the NAMs depend on the properties of the initial solid/liquid medicine used to produce them by shaking even in the same host liquid. This indicates that the NAMs of one Homed are not the copy image of those of another Homed, but they differ in energy/entropy/information content and H-bond structures. These NAMs are embedded permanently in the Homed mixture in disguise as spin remains in disguise in magnetic materials. These NAMs become active as soon as they come in contact with the living cells like that of virus attacking only live cells. The NAM carries its own identity (like spin as mentioned above) in the mixture producing them in the host liquid.

Like virus or nanobacteria (without nucleus) [34], NAM once formed sustains its activity and singularity for years acquiring energy from the surrounding. The NAMs behave, as if, they are open or closed dynamic “Srtings” or magnetic spin. The string/spin like property of the NAMs in the liquid does not depend on the concentration of the therapeutic solute producing the NAMs in the host. Again, it is not the therapeutic medicine or the host liquid, but the impression (or information) acquired by the NAMs from the therapeutic solute-liquid interaction acts as the medicine curing the disease by any Homed. As mentioned earlier, the NAMs of a particular medicine are produced and energized by rigorous agitation (i.e. by successive shaking of the diluted liquid). It should be noted that the NAMs might also form by other means; (say) by low field electric discharge (0-10V) of the mixture for a few hrs or by microwave for a few minutes. After such discharge, the host liquid mixture remains as liquid but its internal physicochemical properties change with the formation NAMs.

(d) Activity of Homed may vary from person to person

Same medicine with similar NAMs might have different disease curing ability when applied to different for the same disease. This is due to different physical character of the different patients under treatment. This is due to the fact that the character of the cells (DNA and chromosomes) depends on the food habits, mentality, personal life, age etc. of the patients. So there is one most important principle of homeopathic medicine is that treatments must be “individualized” and tailored to each person’s specific symptoms, history, body and needs. Present model explains this fact and the dilution dose etc. might vary from one man to the other. It is to be noted that the microscopic interaction of the NAMs with the proteins/enzymes of the diseased cells is very critical depending on the DNA/chromosomes character. The changes of food habit, life style etc. might

affect the cell signaling process and hence the healing process. Therefore, applied dose and medicine potency might vary from patient to patient treated for curing the same disease.

(e) Temperature and pressure effects on homed

According to Benveniste *et al.* [11] “...heating, freeze-thawing or ultra-sonication suppressed the activity of highly diluted solutions, but not the activity of several active compounds at high concentrations. A striking feature was that molecules reacted to heat according to their distinctive heat sensitivity, whereas all highly diluted solutions ceased to be active between 70 and 80 °C. This result suggests a common mechanism operating at high dilution, independent of the nature of the starting molecule”. This is due to the fact that the property and H-bond structure of NAM is modified/destroyed in presence of extreme conditions (heating, pressure, mechanical trust etc.). Therefore, the NAM cluster formation in the host liquid (alcohol or water) might be considered as the unique way of explaining the high dilution Homed controversies.

Summary and conclusion

We have proposed the formation of active H-bonded ions/clusters called pseudo-spin for the explanation of the potency of higher dilution homeopathic medicine. These pseudo-spins are dynamic H-bonded molecules formed while preparing the homeopathic medicine. The higher potency of the higher dilution is due to the higher degree of freedom of the NAMH-bonded units formed by rigorous agitation of starting molecules and the alcohols producing a particular Homed. The H-bonded NAMs carry the impression (cues) of the starting molecules similar to the cases of same silver nano-particles carry the impression of different plants extracts used to produce them by reduction. Medicinal potency depends on the degree of freedom of the NAMs and their character. These highly active NAMs in the medicine quickly interact with the human cells commutating therapeutic information (like cell signaling following information theory of information transmission). This behavior of NAMs are comparable to those of virus and nano-bacterial. Different types of NAMs with different physicochemical properties carry different information to communicate to remedy the diseased cells (as soon as it comes in contact with the diseased human cells). In the therapeutic process, not all molecules of the Homed takes part in the disease curing process, only a few dynamic NAMs in the mixture trigger the curing process. Even a few NAMs are enough to cure the disease. But the Homed must contain the a few NAM (otherwise, it will not work) to cure a typical disease (means a disorder of the normal cell, it should be noted that all normal cells are interconnected and all of them are dynamic motion with a normal mode of vibration; even if a single cell get disturbed or diseased, it is notified and the active ion interact with that disturbed cell to bring to the normal mode of vibration). Sometime, may be after taking several doses, an active ion comes in contact with the body cell to cure the disease or the activation potential of the NAM is not strong enough to fight with the diseased cell. That is why sometime long time treatment is required to cure the disease with a Homed. In such a case, the patient should have patience. By chance, one patient might be cured with one or a few active ions in a single dose of the medicine. The active ions once produced are

inseparable from the host Homed. The idea of the formation of H-bonded active nano-clusters or NAMs is new conjecture might be used to explain many other features of dilute molecular systems.

Finally it is to be noted that understanding therapeutic activity of diluted Homed is very complicated and proper selection of the dose and potency for a typical disease are still more difficult. Therefore, there is enormous chance of mistake and wrong diagnosis. One should not blame Homed as it will not work until NAMs are formed and stabilized which depends on various factors yet to be discoed. More elaborate understanding of NAMs and understanding the selection of the medicine and the dose are also very important to remove the controversial results.

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