Nanotechnology in Agriculture
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Lecture-28
Antioxidant Nanomaterial in Animal Production-Part-III

So, let us resume our lecture on role of nanomaterials in agriculture, so we are into the animal production section, role of nanomaterials in animal production and will continue our story about cerium oxide nanomaterial what we have been talking for a while now. So I told you that this all started in university of central Florida somewhere around I would say 2003 this shows the time when it all started.

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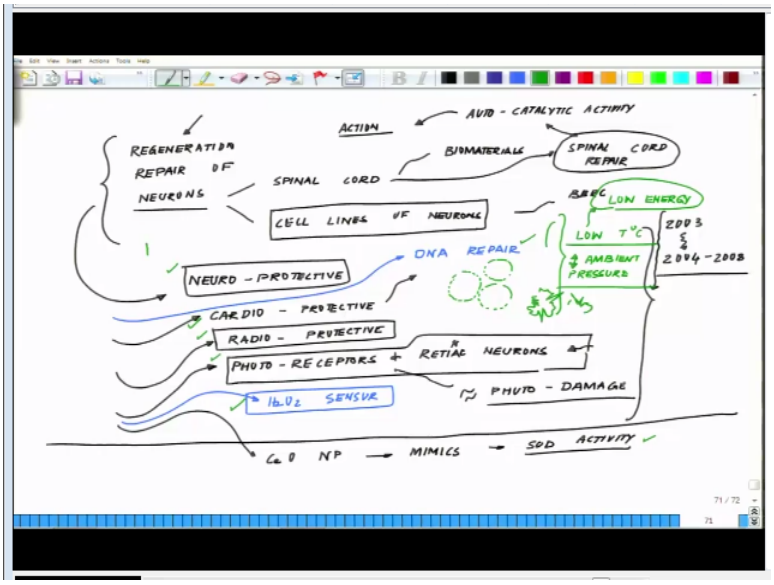

And it showed first of all it showed a radio protective activity, it showed neuro-protective activities especially for spinal cord repair and this is where for the first time in this paper was highlighted autocatalytic terminology for ceria was introduced autocatalytic activity and autocatalytic action, the nomenclature for ceria is autocatalytic mechanism started here. Similarly there was another paper with the cell lines of the neurons came in BBRC by chemical or physical research communications.

Then we have a JBC journal biological chemistry highlighting the work of (()) (02:07) saying it is a it has a cardio protective role simultaneously there was a multiple studies of course by gene

manganese and from Oklahoma eye Centre and, so that they seal the joint work which showed that it helps in recovery of the retinal neuron, so simultaneously there was couple of other work which showed cerium could be used as a drug delivery tool also.

So I am not getting into that part, what is important here is this material showed tremendous promise somewhere around and now we will see terms of papers which are come in this area over last I would say almost 14 years time. And may be some of these earlier studies people have almost forgotten that and where it all started and also same time. There was another very interesting study which came if I am able to write chemical communication which said that cerium and it came from a gentleman called William Self.

And so that to see that there is a joint work came as cerium oxide nanoparticle mimics SOD activity, now if you remember SOD we talked about SOD out here.

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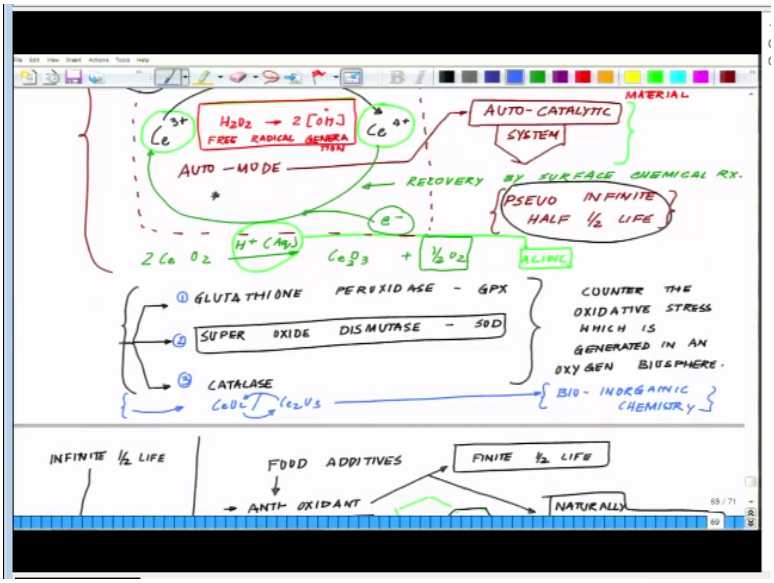

Superoxide dismutase activities, so look at the interesting part how studies evolve, so out here for the first time there is you have 1, 2, 3, what nature has given you, now inorganics is giving you Ce2 or Ce2o3 and new enzyme or new autocatalytic molecule which is doing the same thing as these enzymes are doing.

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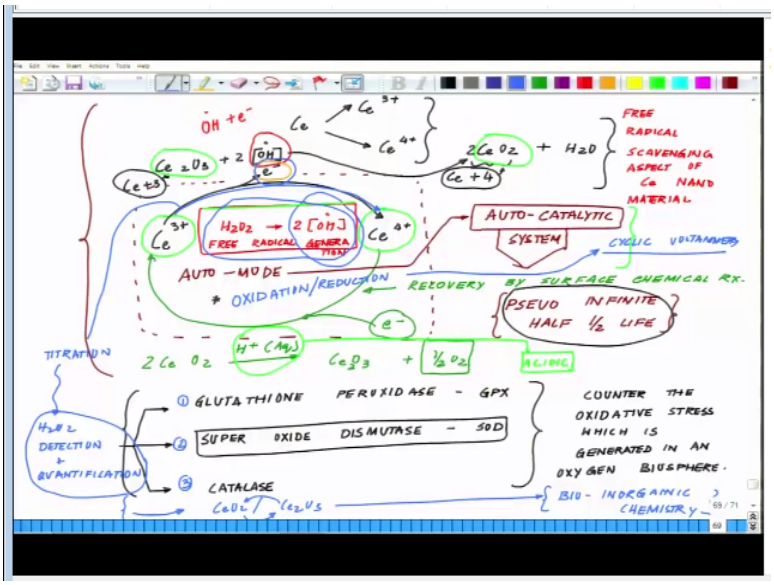

So, this tells us the bio-inorganic origin of powers the whole field of bio-inorganic chemistry are very interesting molecule which is purely inorganic purely, purely inorganic, finds a applications in areas which exactly the naturally occurring enzyme system task, simultaneously there was another interesting area which was quantified showed is around this study came around 13, 14, where, so now you realizing that hydrogen peroxide molecules are getting scavenged ok.

In other the free radicals generated by hydrogen peroxides are getting scavenge. So, if you could do this titration right than so this is the basically a titration which is happening. If you do it the correct titration then you can use cerium as a pro for H2O2 detection or and quantification in a system, because how many molecules of H2O2 is getting transformed and if you really look at this reaction even much more carefully depending on the number of electrons which are getting converted.

So in other word what is happening there is an oxidation and there is a reduction happening. So, if you use techniques like cyclic voltammetry which are electro-chemical technique. You can actually make a hydrogen peroxide sensor hydrogen peroxide quantifying agent how they are and it could do this and not only that there it very interesting study showing. I will come to this sensor part first and then I come to those some of those interesting studies.

This quantification of free radical using cerium oxide nanoparticle could be used there are preliminary study showing could be use now as animal world.

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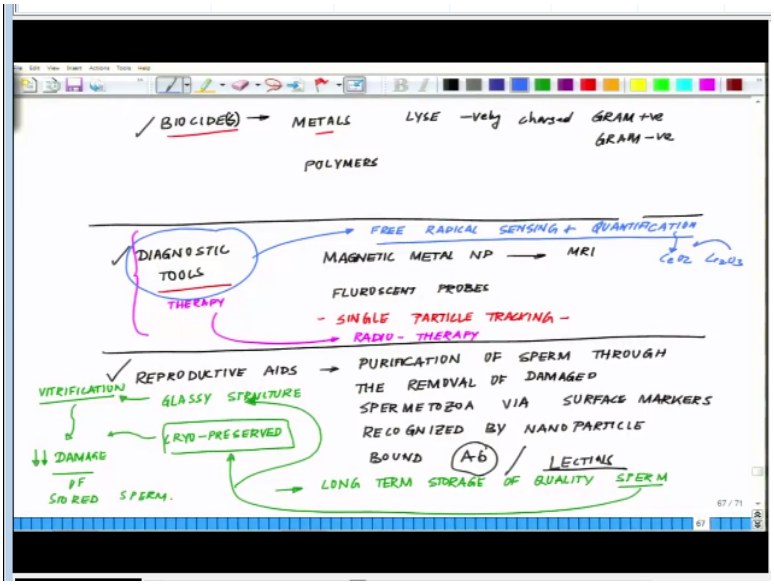

If you talk about as a diagnostic tools for free radical sensing ok and quantification using cerium, a simple inorganic molecule almost now through this last 14 years of tremendous effort around the world which all originating in this center Florida is now to the central stage.

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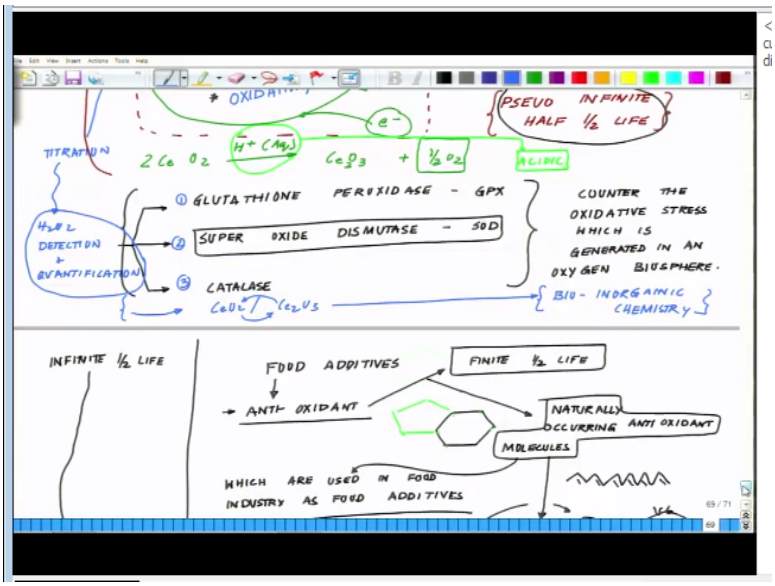

There is another interesting study which showed that cerium helps in DNA repair which was a big area, if you look at some of these molecular biology aspects we talk about one second yeah out there, out here.

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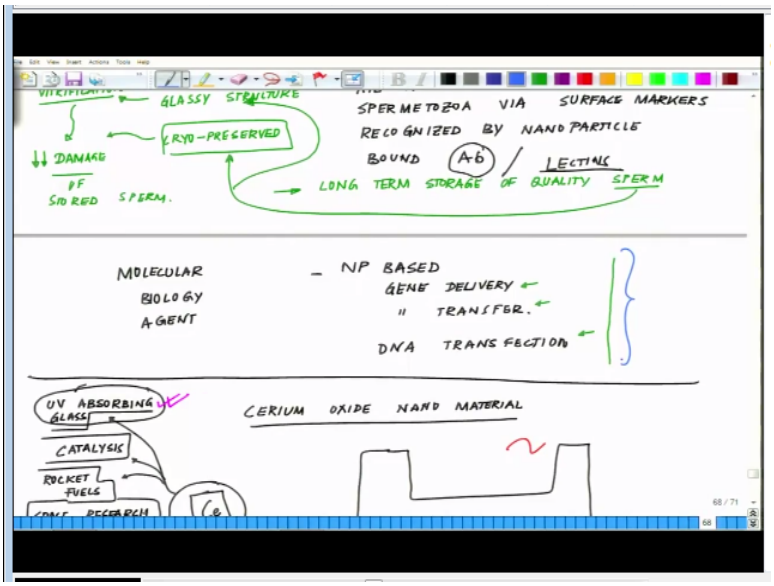

So, the molecule has amazing power and it is fairly biocompatible and the advantage with such molecule is that they are autocatalytic and they are needed in very small amount ok.

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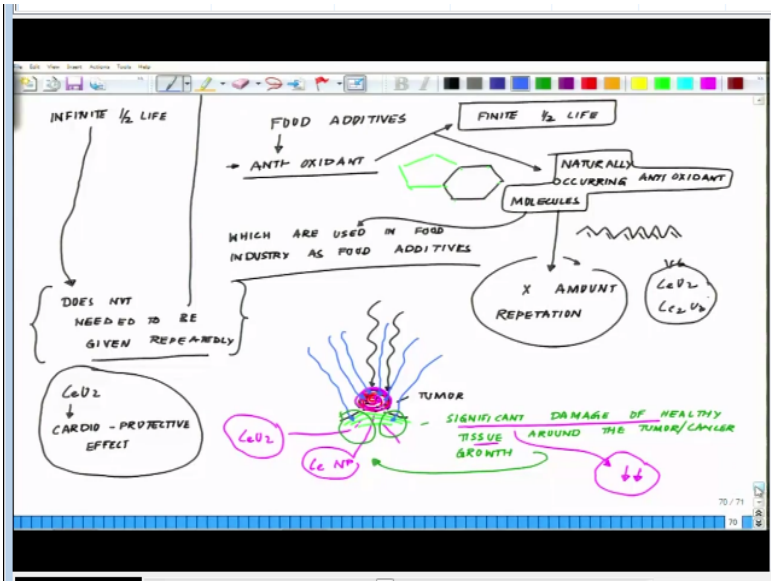

So, among all this let me add one more into this, they helps in DNA repair and this could be used as sensor H2O2 sensor and we have already talked about their role in neurogenesis and all other things. But simultaneously there was another aspect which was evolved in the couple of papers which came from Korea at the time saying that it has toxicity, so this is one area which will always come across whenever we talk about nanomaterials.

But what is interesting to note here is I will take you back to some of those techniques what we taught you in the beginning.

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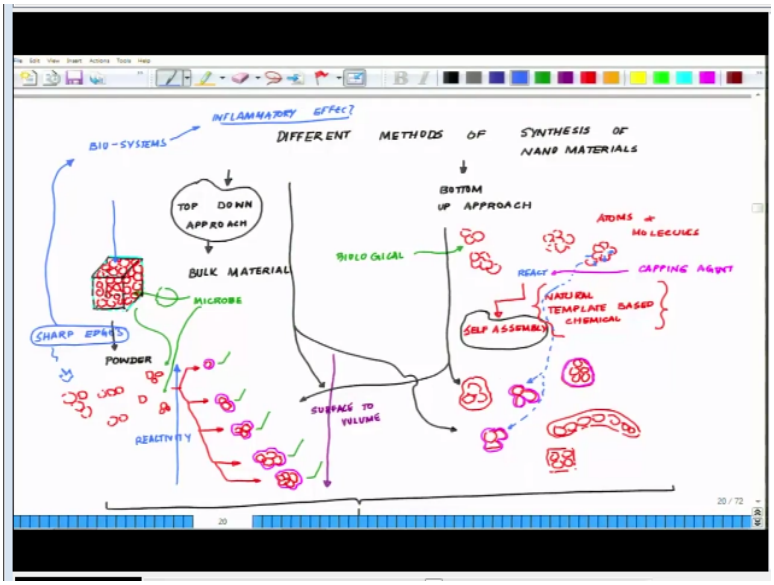

If I take you back if you remember when we talk about how we synthesis nanomaterial in terms of it is synthesis. I will come to the synthesis part different mode of synthesis either you do a top down synthesis or you do a bottom up synthesis. So, whenever we do a top down synthesis we use as we talked about we use ball milling we use different kind of techniques what happen is when we are breaking down a big bulk molecule.

These particles which are generated may have sharp edges and this is very important for you to understand. These kind of sharp edges when you are using in biological systems any kind of bio-systems they may show inflammatory effect. So something which otherwise is exceptionally useful for us may turn out to become a disaster because you synthesized it in a way that will not support the result. So while these studies are coming up from university of central Florida.

And the collaborators of (()) (11:48) Florida hospital or hospital systems Oklahoma eye center study from Salk and the west coast California ohh I sorry I think it is from a scripts not from Salk. The study on neuronal cell lines. There were 2 studies if I remember it right which came up from Korea saying that you know they causes inflammation and one need to look at those paper without rejecting them.

You know this is one bad thing you can do you reject something oh no this is just because you are opposing me, science knowledge understanding is not like that. So, try to understand what does that mean upon looking you realize how the material is being synthesized and that is why it is very important for you guys to understand before allowing anything to get into the body you should know how you are getting this material, it is very important.

So, it was absorbed that much of these synthesis where top down or a very high temperature synthesis which was followed for cerium which is perfectly right. Because cerium also throughout has been used if you look at it cerium all have they, so whenever we talked about cerium I told you the cerium has all being used for rocket fuels, for catalysis, for automobile industry and all other sorts of things.

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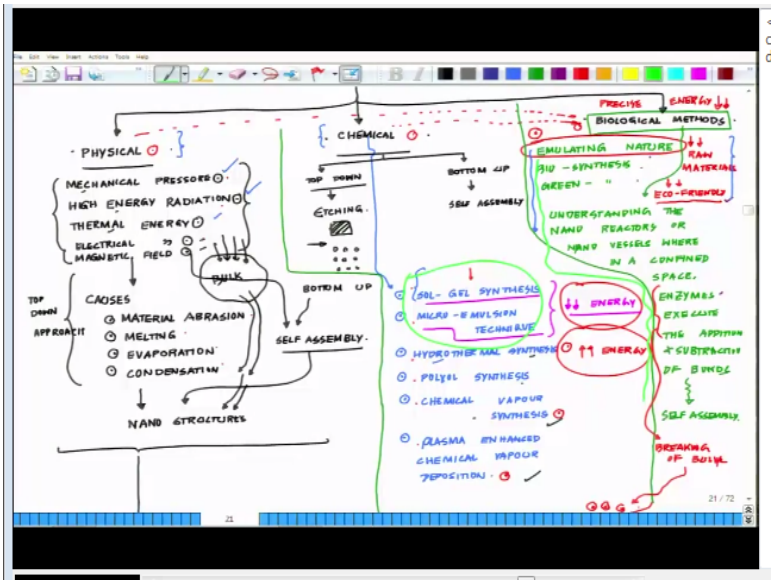

And there was no point for it to be synthesize because you needed bulk quantity and nano cerium was synthesize under those kind of harsh conditions. So what was obtain from those if you use those cerium, they may not be able to show you the kind of amazing beneficial property you see not that they lose your property because those particles have a sharp edges, those particles are not really spherical, not really so uniform.

And that is possibly one of the reason why many of these studies which were being conducted showed contradictory results. It is not the result was wrong, it was material was different, same material but how you are synthesizing, that was one the critical reason why I took in the initial phase of the course that much effort to make you understand that why these kind of synthesis protocol the chemical synthesis, physical synthesis, mechanical pressure, high energy radiation, thermal energy.

And where all these things are moving, so one of the thing what if you remember I highlighted very clearly we are have to emulate nature how we are synthesizing. And I will come highlight one of the synthesis techniques in possibly my next class I will show that initial cerium synthesis where done which showed biological activity where done in a very different way. And as a matter fact that is what people have been following.

Since then they used a SOL-gel reverse micell methods, micro-emulsion techniques and all those, none of them use any of these techniques, they use very simple gentle techniques something like this ok. And much of the efforts are currently on these kind of techniques which are more biologically based techniques which are much more easy technique, much more of course they may not be a very bulk production unit.

But who needed a bulk production unit but who needed a bulk production unit, you could have small production units. And they will be synthesizing at lower temperature, so what is the temperature what you are using, what is the pressure you are using. So, this is the reason one has to look at every study very carefully without getting buyers that you know this result it does not fit in my story line.

It means is a bad result no may not be a bad result may be something which you are missing out completely. So, while talking about, so again revisiting all are very first week lectures not only come back to the real time now. So, while cerium was gaining significance in these areas of neuro-protection, cardio-protection, radio-protection, photo-receptor repair, H_2O_2 sensor, SOD mimetic, DNA repair.

They are all studies in literature which will contradicts some of these, do not get buck down and do not disrespect to those people. They have reasons because they synthesized it in a very different way and slowly because whenever a (()) (16:59) when I am offering this course you know 2, 3 years online this will be even much more broader I mean 20 years online probably people will not even bother and this is all outdated.

So that what is (()) (17:11) to realize how we are getting that material, how this has come to us, so much of these work which was concentrated in one part geographical location, much of these synthesis where which are being done was low temperature synthesis absolutely no ambient pressure sorry put it precisely ambient pressure, absolutely no harsh conditions ok. So some of these things were being maintained there in order to ensure that these particles what you obtain have a very smooth geometry like this.

And this geometry is extremely important that they should not have something like you know sharp edges like this or something like this and being a low temperature means it is a low energy synthesis. It needs much much lesser energy of course that whole process your production will be slightly lesser but you are spending less energy you know it always compensates for it ok.

So, having saved this, in the next class I will move onto one of the synthesis techniques and then I will move onto where they find, they may find applications from the laboratory studies, laboratory trials into the line of animal production ok thank you.