Nanotechnology in Agriculture
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Lecture-29
Antioxidant Nanomaterial in Skeletal Muscle Development Part-I

Welcome back to the lecture series in application of nanomaterials in agriculture. So we are into the section where we are talking about the role of nanomaterial in animal production, so if you remember in the last class we talked about the mode of synthesis and how it affects the results or the desired results. In that process I told you that while a whole new parodying was getting birth in a university of central Florida while working with Cerium oxide nanoparticles.

They were couple of groups who showed that Cerium oxide nanoparticle has inflammatory effect. And I told you that it is the synthesis how we are doing it matters. So, one of the technique which he was followed at that point.

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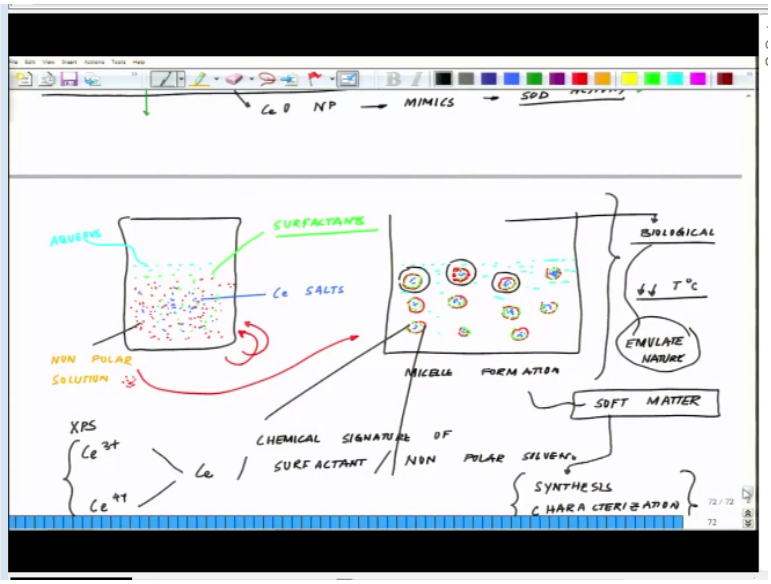

I wanted to highlight is a very interesting technique pretty straight forward though, so you take a precursors so this will take you back to the very first lectures when we devote a time on the synthesis, so now here is an application to say so what you do you take the basically non-polar solutions and the surfactants which are there. So you use the surfactant molecule and some non-polar solutions you are using non-polar.

Because you are doing an aqueous you are working on aqueous system. So you have the non-polar solution which is that may represented by we have the non-polar solution and so let us represent a non-polar solutions in red and you have the surfactant molecules which are represented by green. And then you have the target which is your Cerium what you wanted you make and let us represented by blue ok.

Now let me label them, so you have the green you have the surfactants and if you remember we talked about the surfactants to ensure the reducing the surface energy of the system. And then you have cerium salts and this is all happening in an aqueous environment. So in an aqueous environment what will happen there will be formation of the micelles, so these non-polar stuff in order to reduce energy they will form micelle like structure or micelle formation.

So the micelles will be most likely something like this of the micelle formation. If you sonicate this thing they will form micelle like this ok, the simple surface chemical process you are doing a sonication here pretty any forms spherical shape micelle and it is in an aqueous environment in order to reduce their surface energy, they are forming micelles and this micelles are getting separated because you are using a wide area of surfactant molecules.

Now I am introducing surfactant molecules ok, now in that process what will happen is that a bunch of cerium molecule will get infract inside it because their concentration is fairly higher ok. Now what you are seeing is that each one of these micelle is acting as the nano reactor. So if you analyze this, so you take this one, so you will be seeing the signature chemical signature of using XPS x-ray photo electrons spectroscopy chemical signature of cerium surfactant whatever surfactant molecule you are using and non-polar solvent.

Now Cerium when you look at it, if you look at the XPS you will see Ce3+, Ce4+ and this whole thing we are talking about very very low temperature and in the room condition where you are doing it. So this is what I was trying to highlight that whenever you are synthesizing these kind of particles you should know that how you are getting there because unless you are sure about the genesis how this particle has been formed.

It is really tough, now when you compare this and if you look at their overall geometry how they look like if you take up any of these particles is that unique spherical shape and pretty soft. So, these are the whole area of soft matter, the synthesis and that is why it is very very important that you understand incompleteness that the field you have to understand synthesis. And that is why we spent so much time on synthesis, you have to do the characterization right.

And then of course your testing and whenever you getting contradictory results do not discover the results, you are very fortunate that their results which may tell you how you are getting the material, what are the reasons why are getting certain kind of certain type of results all is look at it very carefully. And this is what can be say, so truly about ceria as the field slowly, slowly emerging, there were things which are coming on surface which was never thought out at that time.

So, wow or this could be a problem now if you go back to the previous slide something like this are sharp (()) (08:19) particle you know instead of showing a positive effect this will lead to some form of an inflammation.

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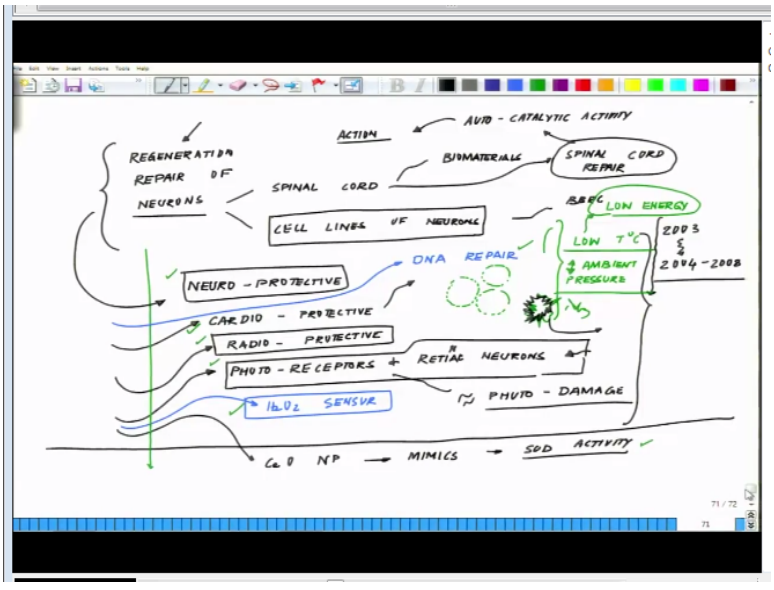

And that what precisely did, now that is the reason why I was telling in the very early synthesis is now moving more towards biological synthesis or in other word we are now trying to emulate

nature, how nature does a stuff in a small nano reactors, how they do it. Now from here what we will do, we will move on to after highlighting this part and kind of you know discussing lot of positive results and handful of negative results and what possibly is the reason for it.

We will move on to one of the very interesting aspects of exercise biology, so all of you do exercise right, some have the ability to do heavy exercise, some cannot do, they feel tired, why we do feel tired, why some can do heavy exercise. And this exercise biology has a lot of role in animal production, you know they are bullock cords where animal does the exercise, you have horse riding where the animal does exercise.

You have series of them where exercise biology place a critical role in animal production. But if you ask a physiologist about exercise and its benefits pros and cons you have one of the most ambiguous answer, what has emerged over the year is something which may stun some of you those were not aware about exercise, exercise is a kind of double edged sword to tell it very precisely, exercise is a double edged sword for skeletal muscle ok.

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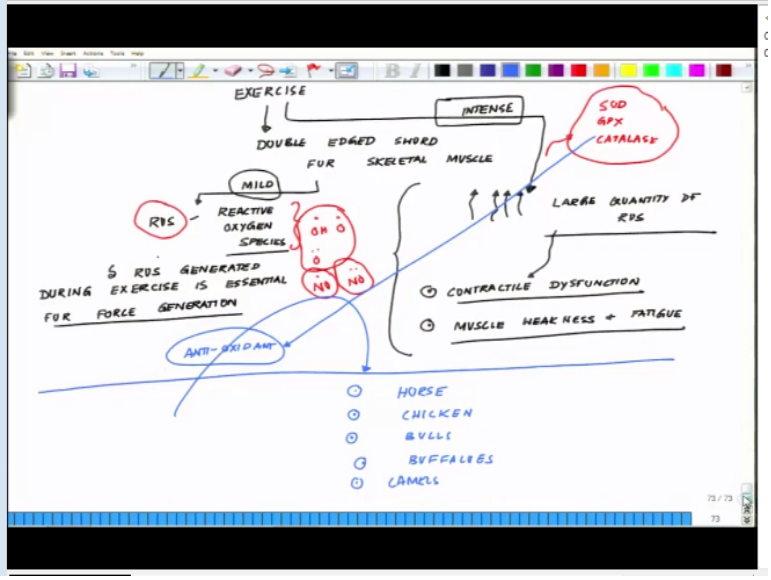

Why is it a double edged sword for a skeletal muscle because small amount of ROS is generated during mild exercise, so during exercise it generated ROS or reactive oxygen species ok. The small amount of ROS which is generated during exercise is delta amount of ROS generated

during exercise is essential for force generation or skeletal muscle force generation, this is very critical ok and must as a matter fact, whereas large quantity of ROS is generated.

Now here you are doing a mild exercise ok, suppose you are one of those you are what doing very intense exercise, now during intense exercise large quantity of ROS is being generated, large quantity of ROS ok, this large quantity of ROS which is generated during intense exercise may cause contractile dysfunction as well as it may cause muscle weakness and fatigue.

So if you see the same exercise which is essential for cogeneration when you are doing mild exercise has a totally different scenario when we do intense exercise. And so say for example a person has some kind of problems in hypothetical situation and with SOD or GPX or catalyze the antioxidant enzyme, so you realizing if you are generating reactive oxygen species which is .OH .O, ..O and all those kind of NO. NO.. you know series of those reactive oxygen species.

These has to be scavenged by antioxidant unless they are being scavenge by antioxidant enzymes. We will have serious issues and exercise biology, so you know those who work on horse production, those who I mean let us look where you need these kind of situation arises. Say for example those who work on horses, those who work on chicken or meat, those who work bulls, those who work on buffaloes, camels, where there is tremendous amount of I am just to name a few and I am talking about once again ok.

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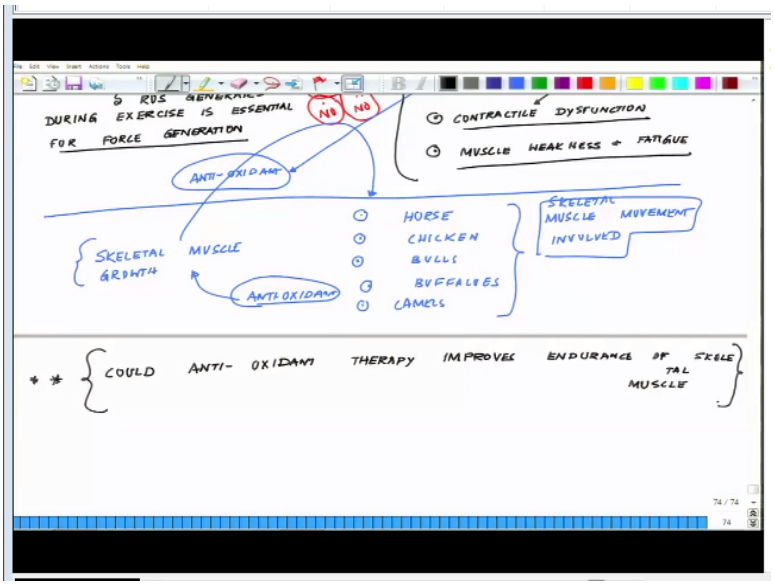

So, this is where there is huge amount of muscle movement involved, so whenever we talked about lot of muscle movement we are essentially talking about especially in terms of skeletal muscle movements, so when we talk about ok let me this be little bit more specific skeletal muscle movement involved. And skeletal muscle is the key part of the muscle which is consume for meat production.

So skeletal muscle dysfunction due to high concentration of ROS may not be beneficial for the animal producers or for people who are training the horses for race horse race or running and equestrian series of the them from difference applications to the sports, there is whole range of areas where animals are needed not at that situation what they do.

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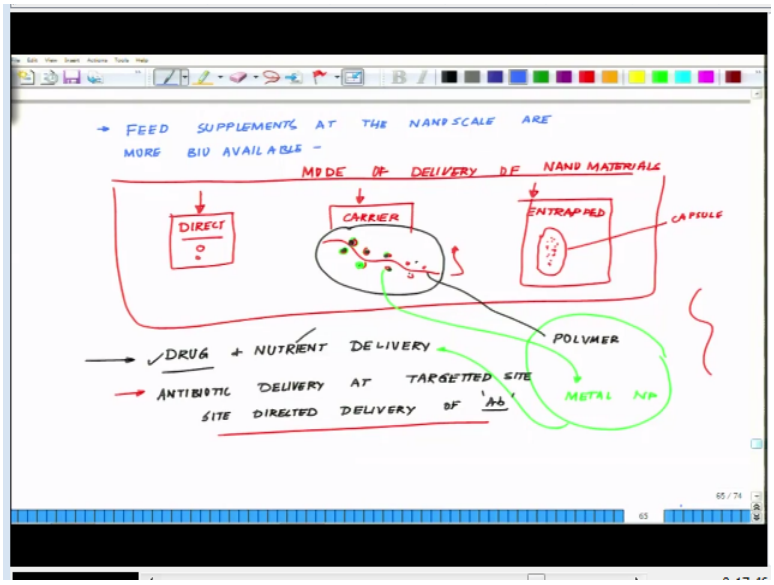

If you look at it when we talk about where all the animal stuffs goes, I told you there is a whole area of nutraceuticals.

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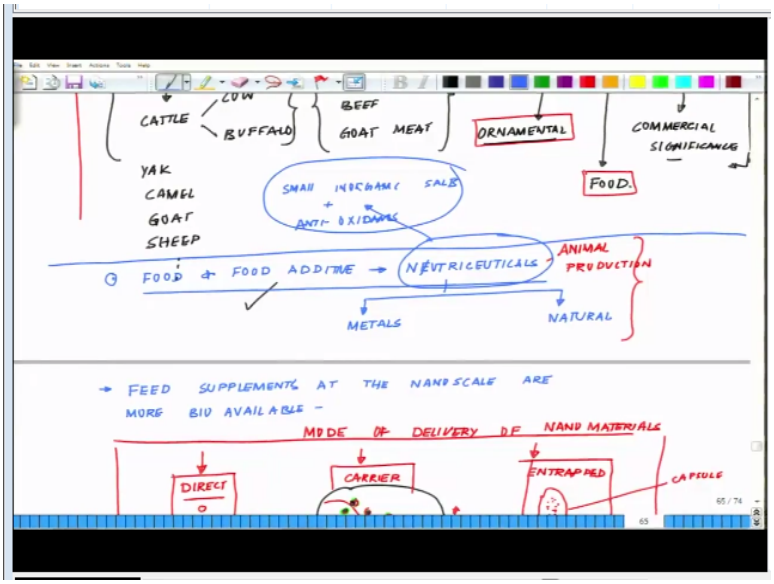

So, much of these nutraceuticals what you will observe are small inorganic salt and + lot, lot, lot of antioxidants which are being given, now does not make sense to you why you needed to supplement or huge amount of antioxidant into the diet of the animals. Because if you really want very good qualities skeletal muscle growth coming back here I was ok, if you really want very good quality skeletal muscle growth you needed to have a lot of antioxidants.

You needed to supplement them with antioxidant, the reason being because whether they are doing mild exercise mostly they do heavy exercise most of the time they moving around whatever they will be generating lot of reactive actions species. So, now that the reason why I take you there.

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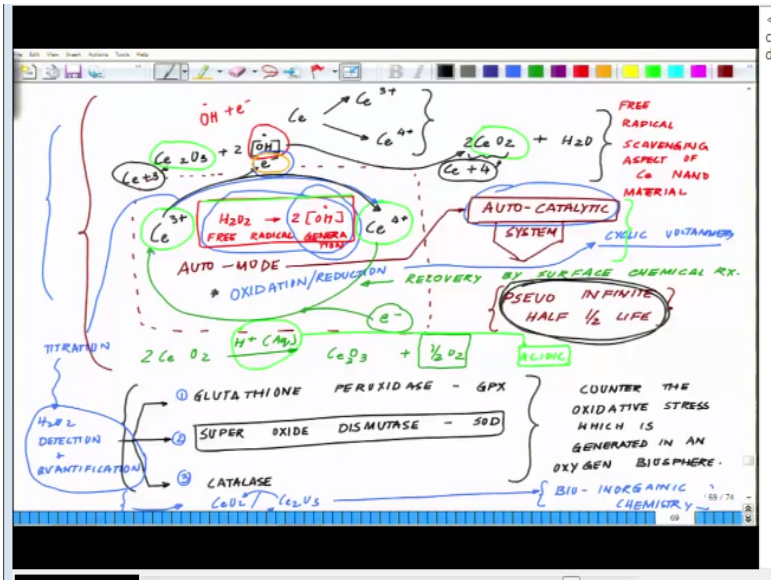

Because now I will take you back to reaction which I started probably 3 or4 classes back, here is the reaction back, here you have one very interesting molecule which has a pseudo infinite half-life, in a very small concentration, now much of these diets. So, there is another very interesting aspects what I wanted to highlight here is, it has been observe that one of the critical question which has been asked was skeletal muscle physiology is could antioxidant therapy improve skeletal muscle endurance ok could antioxidant therapy improves endurance of skeletal muscle very very critical question.

And this is the aspects what I wanted to highlight now at what are the results and where we are headings. I will close in here in the next class we talk about the antioxidant therapy and how it all affects skeletal muscle physiology, thank you.