## The Importance of Vitamin A in the Cow Herd

## Season 1, Episode 53

[Intro music]

**Kiernan Brandt:**

Welcome to Cattle HQ, a podcast from industry experts and progressive producers discussing cutting edge info about the cow calf sector to keep cattlemen and women in the know and positively affect their bottom line.

**Robin Salverson:**

Welcome to Cattle HQ brought to you by South Dakota State University Extension. I am Robin Salverson, Cow/Calf Field Specialist hanging out in Northwestern South Dakota. I am joined by Madison Kovarna, SDSU Extension Beef Nutrition Field Specialist, and Madison will be my co-host for this episode. Our guest is Dr. Hannah Speer and she’s an Assistant Professor with Montana State University. So, welcome to Cattle HQ, Hannah. We’re glad to have you here.

**Hannah Speer:**

Well, thanks, Robin for inviting me. Happy to be here.

**Robin Salverson:**

After listening to your presentation on your research related to vitamin A in the cow herd and I got to listen to you during the Cattlemen’s Academy, excuse me, in Miles City hosted by Montana State University Extension, and after I listened to your presentation, I knew I really wanted you on the episode for Cattle HQ. I’m so thankful that you agreed to do it and then I have Madison onboard with me too [Laughter] to be my co-host. With that, can you share some about yourself, where you came from and where you are now?

**Hannah Speer:**

Yes, of course. I actually grew up in Southwest Kansas. A small town in southwest Kansas. It’s big feedlot, a big dairy country out there. That’s where I grew up and then I went and did my undergraduate degree at Fort Hays State University in Hays, Kansas where I majored in Animal Science and then from there, while I was taking my courses in undergrad, I thought nutrition was really cool, so I decided to go on and pursue a masters which I completed at K-State, and then from there I branched out of Kansas and went to Nebraska for my PhD which I got in ruminant nutrition last August, and I got my specialization in cow/calf nutrition and management. That’s my training, and now I am currently, I’ve been with Montana State University since January of this year and I am an assistant professor and I’m located actually off campus at the Northern Ag Research Center in Havre, Montana.

**Robin Salverson:**

I know when we are visiting in Miles City you said you grew up in the feedlot world. Your masters program with more in the feedlot sector, and then if I remember it correctly and if I’m wrong, you just tell me I’m wrong, and then like you said, you branched out into Nebraska more into the cow/calf and forage range type environment. Is that right?

**Hannah Speer:**

Yes. With my masters, it was a lot of basic science, so I essentially did metabolism studies for my master’s project, and then I decided that extension or applied research was maybe something that I was more interested in so that’s where UNL came in and it was a really good fit for me. Yes, oddly enough, I actually worked with cows in both range and I worked pretty extensively with cows that were being managed in drylot as well. That was something unique and different that I got to experience when I was at UNL as well.

**Robin Salverson:**

You got a pretty diverse background which is great.

**Hannah Speer:**

Yes.

**Robin Salverson:**

Why we want you on this episode too. [Laughter] Like I said, while I was in Miles City, I got to listen to your presentation on vitamin A and I was really intrigued by your presentation and that’s why I really wanted you here on our Cattle HQ podcast. So, let’s dive into vitamin A and maybe start with some of the basic information about vitamin A. But, what feeds are naturally high in vitamin A?

**Hannah Speer:**

Yes, so with cattle, just in general, with vitamin A, there is what we call the preformed vitamin A that can be found in feeds so that’s the form that can immediately be absorbed and used by the body, however, that is found in animal products and we’re not feeding that to cattle, so cattle really have to rely on forages to get vitamin A in their diet. It’s also important that they get that in their diet because the body can’t make that. Being a fat-soluble vitamin, vitamin A is actually highest in fresh green forages, so they’re getting a lot of what we call vitamin A precursor so beta-carotene is the primary form of vitamin A that is coming from those feeds and that’s always going to be highest in our fresh green forages because actually vitamin A is associated to some extent with chlorophyll in our forages so the greener the forage, the fresher the forage, the higher the vitamin A content. So, just in general, color can really tell you a lot about the vitamin A content that you see in your feed stuffs. Even a really good green hay, the reason I say fresh is because vitamin A and that beta-carotene are actually very sensitive to things like heat and light and moisture, so depending on harvest conditions and storage conditions of that hay, the vitamin A content reduces quite significantly. So, green is always good, but fresh and green is always better.

**Robin Salverson:**

Also, I believe, let’s talk a little bit about silage in that silage is a bit higher in vitamin A than we anticipate. Can you explain why silage would be higher in vitamin A?

**Hannah Speer:**

Yes. Silage, it’s kind of the intermediate, in between fresh green forage and like a really good green hay in terms of vitamin A content and that will vary, quite the concentrations in that vary quite a bit as well again due to harvest conditions, storage conditions and things like that. But, actually, because silage is if it’s packed well and stored well, it should be in an oxygen-limited environment. You’re actually preserving some of that beta-carotene in the feed stuff because beta- carotene is also very sensitive to things like oxygen so it’s very prone to oxidation. So, if your silage storage conditions and you packed it well are really good, then vitamin A content that could also be a pretty significant source of vitamin A for cattle in their diets.

**Madison Kovarna:**

Hey, this is Madison just popping in to our – however, it will be different in the recording. But one of the things that I always find interesting with beta-carotene coming in from diet is that inadvertently, it can change fat color. So, that’s one of the things that I think producers are inadvertently more familiar with vitamin A than they may be think because if we have to keep raising them in fresh grass that’s where our yellow fat comes from. It’s cool that you’ve seen both sides of the coin so that you can differentiate between mature cows versus maybe something somewhere else.

**Hannah Speer:**

Yes, and so with cattle too, I know, at least, there’s been a lot more work done in the dairy breeds, but there’s actually an enzyme in their intestine that can boost beta-carotene to those usable forms of vitamin A in the body. That enzyme is pretty inefficient in cattle, but there have been differences in like Jerseys and Holsteins. If you notice anything about Jersey milk fat color, it’s typically more yellow compared to a Holstein and that’s because that enzyme, they have, at least, found out in dairy cattle is significantly less efficient at converting that beta-carotene, so more of it gets distributed into things like milk and fat. So, yes, it is interesting. I should say too beta-carotene, it’s what we think of when we see like red, orange, yellow pigments in feeds so I know it’s strange to say that it’s found in large amounts in green forages, so we do get a little bit of carotene from if we’re feeding like corn, for example, it’s obviously yellow so it’s got a lot, but just in general, grains and our grain byproducts aren’t going to provide a significant amount of vitamin A to that cow’s diet.

**Robin Salverson:**

Hannah, you just shared the various feed stuff. When it comes to the animal, vitamin A is stored in the liver, if I remember that correctly, but I know you mentioned during your presentation, you said and I wrote this down that it is tightly controlled by the body. What does that mean?

**Hannah Speer:**

Vitamin A, it actually acts like a lot of our trace minerals in the bloodstream when we think about how it’s regulated in the bloodstream. Because vitamin A has pretty important roles with immune function and reproduction even like on a gene level, it can regulate gene expression, so we want that to be very tightly regulated so that plasma level or that blood level of vitamin A isn’t going to fluctuate a ton. An analogy that actually as Steph Hansen from Iowa State, I took a class with her, used that is really helpful in understanding how that’s regulated is the liver is the fuel tank and the bloodstream is the fuel line, so the liver is used to keep that vitamin A at a very tight level, or I guess I should say at a pretty consistent level and you really won’t see that blood vitamin A drop or go down unless liver stores are completely tanked. So, yes, it’s very tightly regulated in the liver. 90% of the body’s vitamin A is stored in the liver so that’s primarily what the body’s pulling from to maintain those levels in the plasma. So, blood can be a useful tool to diagnose vitamin A status, but liver and also the way that vitamin A is metabolized in the body as well. Intake or if we have higher vitamin A intakes, we won’t really see a lot of fluctuation in the blood, but we will if we get to the liver since that’s where it’s primarily stored. The liver is just used to essentially keep vitamin A or maintain a consistent level in the blood.

**Robin Salverson:**

You mentioned if anybody has a concern about a vitamin A deficiency, the liver would be something that they test, not the blood plasma just like copper and some of those other ones. Right?

**Hannah Speer:**

Yes. You know I’m not saying blood is not useful. It is, but it really tells you you’re okay or you’re not okay and by that point if you’re not, if you’re really low levels then the liver stores are probably pretty well-depleted. So, in my opinion, the liver gives you a kind of a better picture where that cow is out of that point in time since that’s the one that fluctuates with dietary vitamin A intake. But yes, I would say the liver gives you a better idea of the cow’s status at a particular point in time versus a blood sample.

**Robin Salverson:**

Vitamin A does not transfer across the placenta. Is that correct?

**Hannah Speer:**

Yes.

**Robin Salverson:**

That means when a baby calf is born, that calf is actually deficient or void of vitamin A?

**Hannah Speer:**

Correct.

**Robin Salverson:**

Where is that calf getting that vitamin A then?

**Hannah Speer:**

The vitamin A that that calf is going to be getting is going to be coming in colostrum which colostrum has a lot of other good things in it, but because vitamin A and just in general, are fat-soluble vitamins don’t transfer across that placenta, a lot of that is getting put, the vitamin A is getting put into the colostrum so that’s what that calf’s really going to rely on after birth to kind of establish its own vitamin A stores and get that vitamin A that it needs.

**Robin Salverson:**

Again, referencing back to your presentation in Miles City, you mentioned that within the colostrum 40% of the vitamin A comes from storage and 60% from the diet. Did I write that down right when I was taking notes?

**Hannah Speer:**

That is correct, yes.

**Robin Salverson:**

I feel I’m pretty proud of my note taking here. [Laughter]

**Hannah Speer:**

You’re awesome.

**Robin Salverson:**

[Laughter] What does that mean? I mean for a producer when it comes to feeding that cow or making sure that that vitamin A is sufficient enough to be transferred through the colostrum to that baby calf? Because, I also believe within your research, you found that even though the cow had sufficient levels or adequate levels of vitamin A, that calf was actually deficient.

**Hannah Speer:**

Yes. The one study you’re referring to we actually brought cows in to the drylot. They’ve been out grazing summer pasture and they came in with pretty good, we had tested their liver vitamin A levels and they came in with pretty good stores, but when we supplemented them, we actually only supplemented about a third and two-thirds of that vitamin A or the current vitamin A recommended amount. What we did find is that at those lower vitamin A supplemental levels, because our theory was, well, if the cow has got good vitamin A liver stores, the cow should be fine. But, actually, what we found is that even though a lot of our cows still had good adequate status, 30 days after calving, the calves about a majority of them fell about, their liver levels based on what we know for current reference ranges at a lab diagnostic that I’ve used to define adequacy with looking at liver vitamin A concentrations, they were about half of what they should have been in order to be considered adequate based on liver vitamin A levels. Again, I think what you had mentioned earlier, it really emphasizes the point. We found some earlier literature from the 70s that actually looked at how much vitamin A is coming from the cow’s own liver stores and how much is coming from her diet and going into that colostrum, and again 60% was coming from the diet. So, it’s good for her to have good liver vitamin A stores to get vitamin A into the colostrum for that calf, but diet makes up 60% of that vitamin A as well. So, it wasn’t enough that those cows just came in with good vitamin A liver stores. We weren’t supplementing them enough in their diet, so I think that’s kind of the take home is that, yes, liver stores are important for the cow to have going into calving, but it’s also important that she’s getting enough from her diet as well because both pools of vitamin A are going to be contributing that colostrum or that colostrum vitamin A.

**Madison Kovarna:**

I think all the points that you’re bringing up are things that we always preach that better colostrum quality and we always want to use it the best that we can, but you bring up a point of they could come in adequate, but that diet during that month where they’re really putting all their energy into making that colostrum really starts to raise its head a little bit of we can’t just say, they’re good right now. I also really liked how you mentioned that the colostrum is important to the calf as setting that baseline because I mean we’re always talking to producers about making sure that calf gets colostrum as soon as possible and also with just making sure vitamin A is coming in adequately too. It’s both sides of the coin. The colostrum can be the best that we can, but if it’s already lower than we need it to be, they’re maybe not are going to get it all the stuff that they need. I really liked how you packaged that up and really piece it apart like that. It really makes everything flow together super nicely and bringing in that last bit. But I had a question for you. You mentioned a little bit earlier that we can put in supplements of vitamin A, but what are maybe the easiest ways to increase vitamin A content in a diet outside of our normal forage sources, I guess?

**Hannah Speer:**

Yes. The best method in my opinion is just to do an in-feed supplements whether that’s a vitamin trace mineral package that you’re feeding out in a loose mineral or if you happen to be feeding a TMR, that’s even great. You can work it into like a pellet or some other supplemental pellet or protein source if they might be given around that time as well. So, I always say that getting it through the feed is probably the best option in addition to the regular diet. Like I said, we’ve got some published values of what vitamin A content could be in different feed stuffs, but that range is so variable because there are so many factors that can cause you to lose vitamin A activity essentially in your forages, so people rarely test for that. So, definitely getting it in the feed whether that’s from a vitamin trace mineral like loose mineral that you’re feeding or a supplemental pellet of some kind.

**Robin Salverson:**

When would the best time be, though, Hannah, in regards to thinking about colostrum, building that colostrum up and to best benefit the calf at the end?

**Hannah Speer:**

Based on some of that research that I just shared with you and also looking back and figuring out 60/40, 60 is coming from the guy and 40% vitamin A is coming from the cow’s own stores. But, kind of those to think that maybe late gestation would probably be the key time to start thinking about looking hard at what your vitamin A program or I guess your vitamin mineral program, but that might be a strategic time to start up in the vitamin A, because looking at when colostrum formation starts, it starts in the last few weeks before calving. So, if we’re targeting, it’s important that the cow has good vitamin A status, but if we’re thinking about it from the calf side of things then late gestation would be a good time to start upping the vitamin A, especially, I know most where I’m at now, in Montana, majority of the people are spring calving, so they’re already feeding stored feeds or maybe a TMR of some sort during that late gestation window. Because they’re getting less vitamin A in their diet, but also thinking about the calf that late gestation would be a good time to think about, yes, upping the vitamin A.

**Robin Salverson:**

What about injections of vitamin A or like an injection that includes vitamin A? I am just curious on maybe what are your thoughts, maybe some benefits, concerns, those kinds of things?

**Hannah Speer:**

Injections, those vitamin A injectable products and typically they do come with like a vitamin D or maybe it’s an A, D and E shot as well, I always say that those are good tools to have in the toolbox. If you had like a tough summer, it was drought and you maybe fed hay a lot longer than you wanted to and maybe they didn’t eat a lot of supplement, but vitamin A is really good in emergencies. It’s like we’re approaching a severe deficiency and we need to get those stores boosted quickly because with an injectable, you’re actually bypassing the rumen, the gut and it’s going directly into the bloodstream so it’s a very available source of vitamin A and it can boost cow stores pretty quickly within a few days up to a couple of weeks, and so that would be a good situation to maybe think about using an injectable. I’ve heard also a lot of people have just made it a standard procedure to give an injectable vitamin product when the calf is born, especially, if you’d gone through a tough summer, or you had to feed maybe some lower quality feeds. It’s always a good thing to have in case of an emergency, but my folks always get them, get it in the feed daily so you don’t get those situations where you might have a severe deficiency on your hands. But again, injectables, they’re a good tool to have, but I wouldn’t use them either as a sole source of vitamin. Because I mean if you think about the time and the labor that goes into rounding all your cows up to give them an injection every couple of months because that’s about how long liver stores last when you get one of those products. It’s a significant time investment and money-wise it could add up on you as well. So yes, definitely, I wouldn’t advocate for using them as your sole source of vitamin A coming into the cow, but it’s a good to have in emergencies like that.

**Madison Kovarna:**

On question I was going to ask for you, Hannah, as we talked about we have to include it in the diet and the injections work, but we shouldn’t make them our whole game plan. They shouldn’t be our only play in the playbook. But is there ever a concern of vitamin A overdosing, or is there a certain level that we can get to where we might see some negative effects, or is that may not as much of a concern in the diet form, at least, more of a concern the other way?

**Hannah Speer:**

That’s a good question. Because vitamin A is a fat-soluble vitamin in other species you can feed too much at one time start causing some toxicity issues, but with cattle and all the reading that I’ve done, I have not ever come across a case of vitamin A toxicity, at least, in cattle. That’s because there is some, the form of vitamin A that they typically put in our supplements. There is some rumen degradation that happens with that and in addition to that, the cattle, the cow’s body is pretty good at regulating. So, if liver stores are approaching maximal capacity, then the body will start to excrete more because there’s some regulation mechanisms going on that say, “We’ve got enough. we don’t need any more,” so more vitamin A will be excreted and less will be stored. So, in the case of providing it in the feed, no. You have to feed really, really large amounts which most people don’t do because it’s not cost-effective to do that. But with injectables, I also haven’t heard of cases of toxicity, but something that I’ve learned recently about vitamin or injectable vitamin products is that there can be some anaphylaxis so your cows could potentially experience, it doesn’t happen that often, but it’s always a risk with any injection that you give really. But with those vitamin, injectable vitamin products, there have been some cases reported of anaphylactic shock. I talked to different vets about that. I’m like, “What’s causing that?” Some suspect that maybe there’s another nutrient deficiency going on and you overloaded the system now with a lot of vitamin A or water vitamin, in general. So, the cow’s body just doesn’t know how to deal with that much that quickly. There could be some underlying disease that you don’t know about, and again, just overwhelming the immune system. I talked to another vet that said, “well, we typically give if we’re giving vitamin A injectables, we’re usually giving it along with a vaccine or something like that.” Again, just overloading the immune system with too much like vaccine, vitamins. Another theory is that the carriers that some of those, so the liquid that is used to carry those vitamins in that injectable product can maybe cause some sort of adverse reaction in the cows. Nobody really knows, but it’s definitely a risk, but like I said, it doesn’t happen that often, but it’s just something to be aware of when you’re giving those injectable vitamin products.

**Robin Salverson:**

You were saying just to refresh my memory, Hannah, though that you said that, some producers are giving the baby calves at birth. Is that correct also?

**Hannah Speer:**

Yes.

**Robin Salverson:**

Perfect, excellent. I guess I am actually thinking we’re going to be wrapping up this episode of Cattle HQ. But, Hannah, any last things of any of your research projects? I know that you’ve done quite a bit within the world of vitamin A and we just really touched the surface of some of the things that you did, but is there anything else you want to share with the producers, the listeners of our podcast?

**Hannah Speer:**

Yes. Like I said, a lot of my work was actually with cows that were managed in drylot situations and that was another one of my projects that I did was looking at different supplemental amounts of vitamin A because we had a theory that the current vitamin A recommendations maybe weren’t correct for those cows that are getting stored feedstuffs for extended periods of time throughout the year. They don’t have that ability to build those stores compared to cows that might be out on fresh green grass. So, that work suggested to us too that maybe those cows in those situations where you have extended feeding of stored forages or extended time in a drylot that you actually might need to feed about three times of what the current recommended amount is which is about 100,000 IUs per day. We saw too that it helped increase those cow’s liver stores, and also, we saw those calves that received or those claves from the cows that received about three times the current recommended amount also had increased liver vitamin A stores at 30 days of age. Again, it reiterates that we can kind of influence vitamin A stores of the calf through what we supplement the cow, and also, we needed to feed about 100,000 IUs per day to give those cows that have been in this drylot. These are cows that were managed in the drylot 365 days a year. There’s a total confinement system which is maybe the extreme when we think about when people or how long people would normally drylot cows. So yes, that’s kind of another thing too is that maybe those current recommendations we have for vitamin A, we need to think about the diet that the cows been on, what she is on, and maybe adjust our supplemental recommendations given those factors, because currently we don’t have a lot of data to support or data to support just one vitamin A recommendation is applicable because of many different production systems and many different and with modern beef cattle because that recommendation hasn’t been updated since 1976.

**Madison Kovarna:**

One more thought, but I know we’re running out of time, so don’t tell me and ask me after this. What I mean let’s go over on time. But, one thing that I think we’re leaning more towards just as a cattle industry in general is cattle being in drylot situations longer than maybe traditionally they have been before. Just simply do with land constraints, grazing constraints, all of the things we are maybe moving more towards a drylot cow system. I know there’s quite a few producers that are moving that way just simply more towards that combined animal feeding operation with their cows. It’s a good point that you brought up that it’s a completely different management strategy and we really need to take it further outside of just maybe the normal things we think about. So, I think kind of challenging those recommendations with different management choices was a good place to put ourselves as we move forward with how the industry is changing.

**Hannah Speer:**

Yes, definitely.

**Robin Salverson:**

Well, Madison, I’m cutting you off. [Laughter] No nasty-gram for me. I appreciate you being my co-host so I would never do that. [Laughter] So, just a quick recap and if I say something wrong, Hannah, please make sure you correct me. But basically, with vitamin A, it’s stored in the liver and that vitamin A does not transfer through the placenta to the fetus, so it’s really important that producers are focusing on making sure that their cows have vitamin A. Like you said, most likely through the feed is the best option.

**Hannah Speer:**

Yes.

**Robin Salverson:**

At late gestation so that that colostrum is built up with vitamin A so that when that calf starts suckling when it hits the ground it’s getting its vitamin A that it needs because when it’s being born, it’s actually void or deficient of vitamin A. So, I said that all right?

**Hannah Speer:**

Yes.

**Robin Salverson:**

Awesome. So, those are just a few recaps and then like she shared that these are all data from 1976. I didn’t write that number down.

**Hannah Speer:**

Yes. The most recent study was done in 1970 and it was used to set the ’76 recommendations.

**Robin Salverson:**

That’s telling us there’s a lot more research that needs to be done based on what Hannah shared with us and that maybe those requirements aren’t quite right yet, so especially as Madison shared then all the various production systems that we have for our cow/calf world. Well, Hannah, thank you so very much. Any last-minute thoughts you want to share with us?

**Hannah Speer:**

No, I don’t think so. I appreciate you inviting me to be on here and thank you for coming to my talk with the Cattle Academy. I was excited to be here. Vitamin A is something I never thought I’d be passionate about, but here I am.

**Robin Salverson:**

Well, you made me passionate about it and I am not even a nutrition person. I love repro, but for a cow to get pregnant, it needs vitamin A, so I get that. [Laughter]

**Hannah Speer:**

Right.

**Robin Salverson:**

What is saying we always say that repro is more important than nutrition, and then Madison will fight back and say nutrition is better, more important than repro, so I think we’re all important. Well, thank you, Hannah. Thank you, Madison, for being my co-host on this episode. Before we end this episode of Cattle HQ, I want to give a shout out to the upcoming Cattle HQ Live monthly webinar sessions that SDSU Extension will be hosting. If you have an interest in our live webinars, go to our Extension website to register and that’s extension.sdstate.edu and just do a search for Cattle HQ Live. Once again, this has been Cattle HQ brought to you by SDSU Extension Headquarters for all things beef cattle. Visit extension.sdstate.edu for the latest beef information. Until our next episode, it takes less muscles to smile than to frown.

**Kiernan Brandt:**

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[Outro music]