



Hemp as a Livestock Feedstuff: A Review of Current Literature

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Abstract

Hemp was removed from the list of controlled substances in the 2018 Farm Bill, making regulated hemp production legal in the United States. Kentucky agriculturalists and entrepreneurs are at the cutting edge of the United States hemp production and processing industries. Hemp production generally falls into one of three categories: grain, fiber, or floral (CBD extraction). Each production category also produces byproducts; one such byproduct is meal. In order to make hemp oil and fiber processing viable, markets for the remaining meal must be found. The high fiber, fat, and protein of hemp meal make it a potential feedstuff for animal agriculture and a potential substitute for soybean meal in many livestock diets. Despite the potential feedstuff value of hemp, nutrition is not the only factor in determining the future of hemp meal in livestock feed. Agriculturalists and consumers are socially biased on the topic of hemp production, which may prevent full utilization of the crop. Additionally, hemp products face regulatory challenges before they can be incorporated into livestock feedstuffs legally. The purpose of this literature review is to describe current research on the nutritional viability, producer acceptance, and legality of hemp products and byproducts as livestock feedstuffs.

Perspective One

Though research on hemp seed as a cattle feedstuff is limited, the results seem to be in favor of the product's potential. There are four general types of hemp feed forms, including hemp meal or cake, hemp seed, hemp seed oil, and whole hemp plant (Cutler, K., Handelman, Z., & Wu, S., 2019, 4). The extraction of oil from hemp seeds is similar to other oil producing plants in that the remaining meal is high in protein (Mufasta et al, 1999, 91). Hemp seed protein also has an amino acid profile that resists degradation in the rumen (Gibb, D. J., Shah, M. A., Mir, P. S. & McAllister, T. A., 2005, 224). Low levels of fiber sources, such as whole hemp seed, introduced into ruminant diets helps to stimulate rumination and salivation, which maintains rumen health (Gibb et al., 2005, 223).

In the Canadian study by Mufasta et al., two non-lactating Holstein dairy cows were fed a 50:50 barley silage diet (1999, 92). Seven grams of borage meal, canola meal, heated canola meal, and hemp meal were weighed and placed into nylon bags (Mufasta et al, 1999, 92). The bags were placed into a polyester mesh bag and then incubated in the rumen of each cow for time lengths of “4, 8, 12, 18, 24, 48, 72 and 96 h” (Mufasta et al, 1999, 92). The chemical analysis of the meal mixtures after time in the rumen showed that hemp meal had higher neutral detergent fiber, acid detergent fiber, and acid detergent lignin than other protein sources (Mufasta et al, 1999, 93). The total available crude protein was similar in all four sources tested (Mufasta et al, 1999, 95). Hemp meal was determined to be “a good source of rumen escape protein, equivalent to heat-treated canola meal” (Mufasta et al, 1999, 95).

The 2005 study conducted by Gibb et al. studied the effects of feeding straight hemp seed to feedlot cattle. The study found that hemp seed increased the 18 C fatty acids in cattle, including C18:0, C18:1, and C18:2 (Gibb et al., 2005, 228). Hemp seed supplementation also increased levels of n-3 fatty acids, specifically C18:3, in the livestock tissue (Gibb et al., 2005, 228). It is also important to note that this study found increased levels of the conjugated lenolic acid isomer cis-9 trans-11 in the cattle fed hemp seed (Gibb et al., 2005, 228). The cis-9 trans-11 isomer is believed to provide humans with a defense against cancer (Gibb et al., 2005, 228). Gibb et al. found that hemp seed positively alters carcass fat without losing feedlot performance and recommended that full-fat hemp be used as a source of protein in cattle (2005, 228).

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Table 3. Performance of steers fed barley-based finishing diets containing 0, 9 or 14% full-fat hemp seed (as-fed)						
Item	Treatment (dietary hemp seed)				P value ^a	0 vs. 9 & 14 ^b
	0%	9%	14%	SEM		
Initial weight (kg)	378.1	380.5	380.4	8.9	0.98	0.19
Days 0 to 56						
DMI (kg d ⁻¹)	10.31	10.34	10.26	0.36	0.99	0.90
Average daily gain (kg)	1.23	1.14	1.27	0.08	0.54	0.82
Gain feed ¹	0.118	0.108	0.121	0.006	0.24	0.62
Days 57 to 166						
DMI (kg d ⁻¹)	7.80	7.87	7.89	0.28	0.98	0.83
Average daily gain (kg)	1.13	1.09	1.10	0.05	0.88	0.65
Gain feed ¹	0.144	0.138	0.140	0.004	0.56	0.32
Days 1 to 166						
DMI (kg d ⁻¹)	8.65	8.71	8.72	0.30	0.98	0.86
Average daily gain (kg)	1.16	1.11	1.16	0.05	0.74	0.66
Gain feed ¹	0.133	0.126	0.133	0.004	0.27	0.32
Final weight (kg)	571.4	564.8	573.9	15.7	0.93	0.62

^aSignificance of differences between treatments.

^bSignificance of effect of hemp seed in diet compared with feeding no hemp seed.

The European Food Safety Authority found that whole hemp plants would be a suitable feed for beef and dairy cattle (2011, 16). The panel also found that hemp seed feed fed to dairy cattle produced milk that was safe for human consumption (European Food Safety Authority, 2011, 16). The review recommended a limit of 10 mg/kg THC in hemp feedstuff, such as “hemp seed with hulls (properly processed), dehulled hemp seed, defatted hemp seed, hemp oil and hemp protein concentrate” (European Food Safety Authority, 2011, 17). However, it suggested that whole hemp plant, hemp hurds, and hemp flour be restricted or prohibited in use for animal nutrition (European Food Safety Authority, 2011, 17).

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Table 4. Carcass traits of steers fed barley-based finishing diets containing 0, 9 or 14% full-fat hemp seed (as-fed)						
Item	Treatment (dietary hemp seed)				P value ^a	0 vs. 9 & 14 ^b
	0%	9%	14%	SEM		
Carcass weight (kg)	325.7	323.0	330.2	9.6	0.87	0.94
Dressing percentage	56.8	57.3	57.7	0.49	0.47	0.27
Backfat (mm)	14.7	14.1	16.3	0.97	0.26	0.66
Ribeye area (cm ²)	79.5	78.9	96.3	12.6	0.54	0.60
Quality grade ^c	2.47	2.26	2.42	0.13	0.49	0.41
Meat yield (%)	54.9	55.2	57.0	0.85	0.72	0.72
Abscessed livers (%)	52.6	68.4	57.9	11.5	0.61	0.46
Severely abscessed livers (%)	42.1	57.9	52.6	11.7	0.63	0.36
Abscessed lungs (%)	15.8	21.1	21.1	9.3	0.90	0.65

^aSignificance of differences between treatments.

^bSignificance of effect of hemp seed in diet compared with feeding no hemp seed.

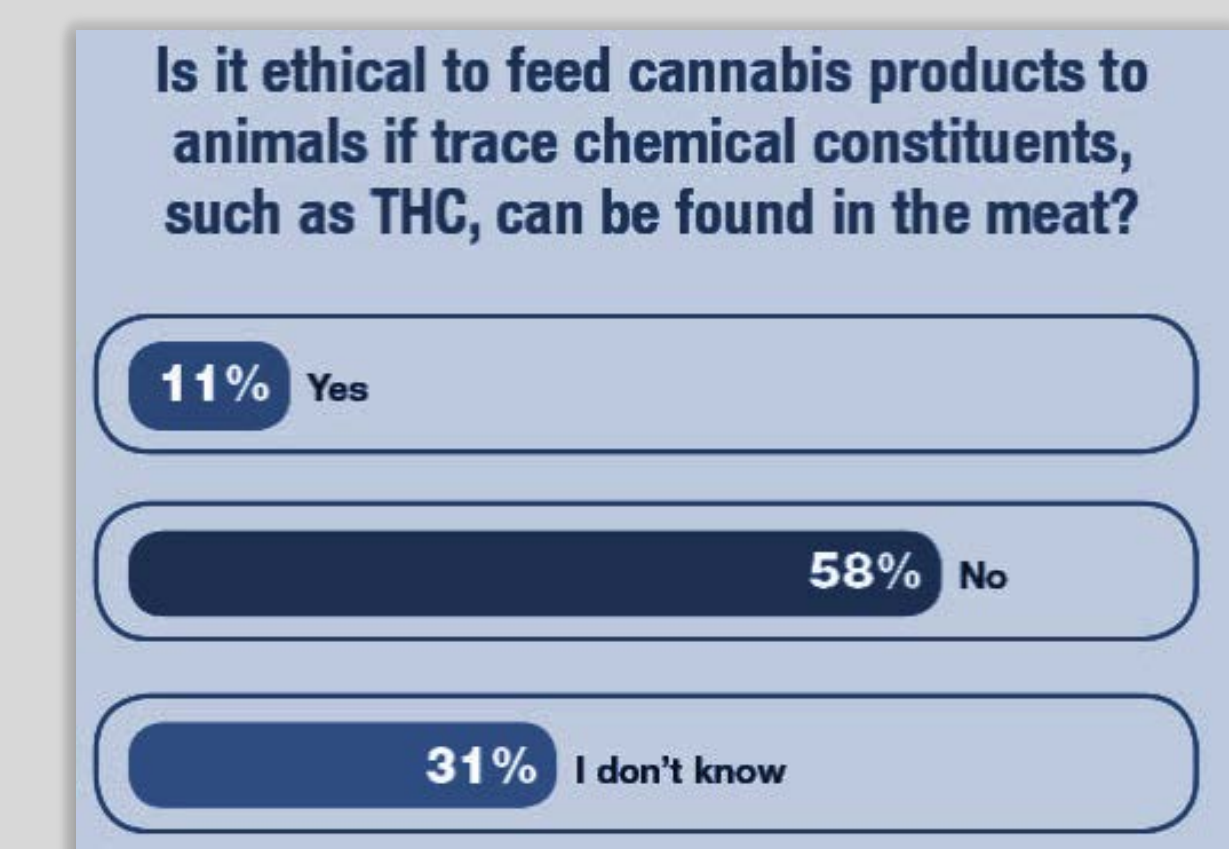
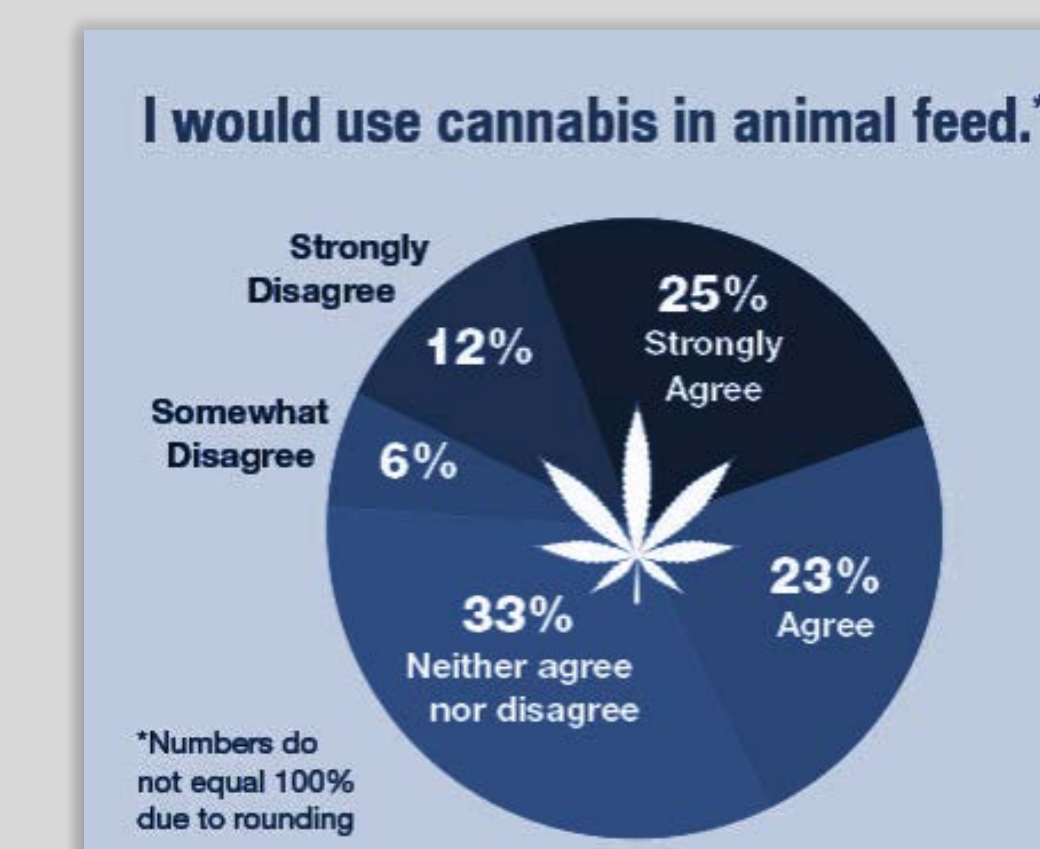
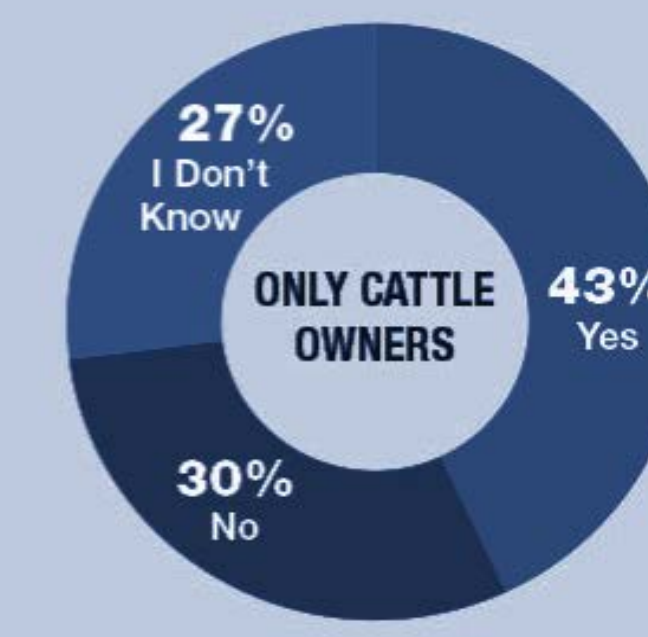
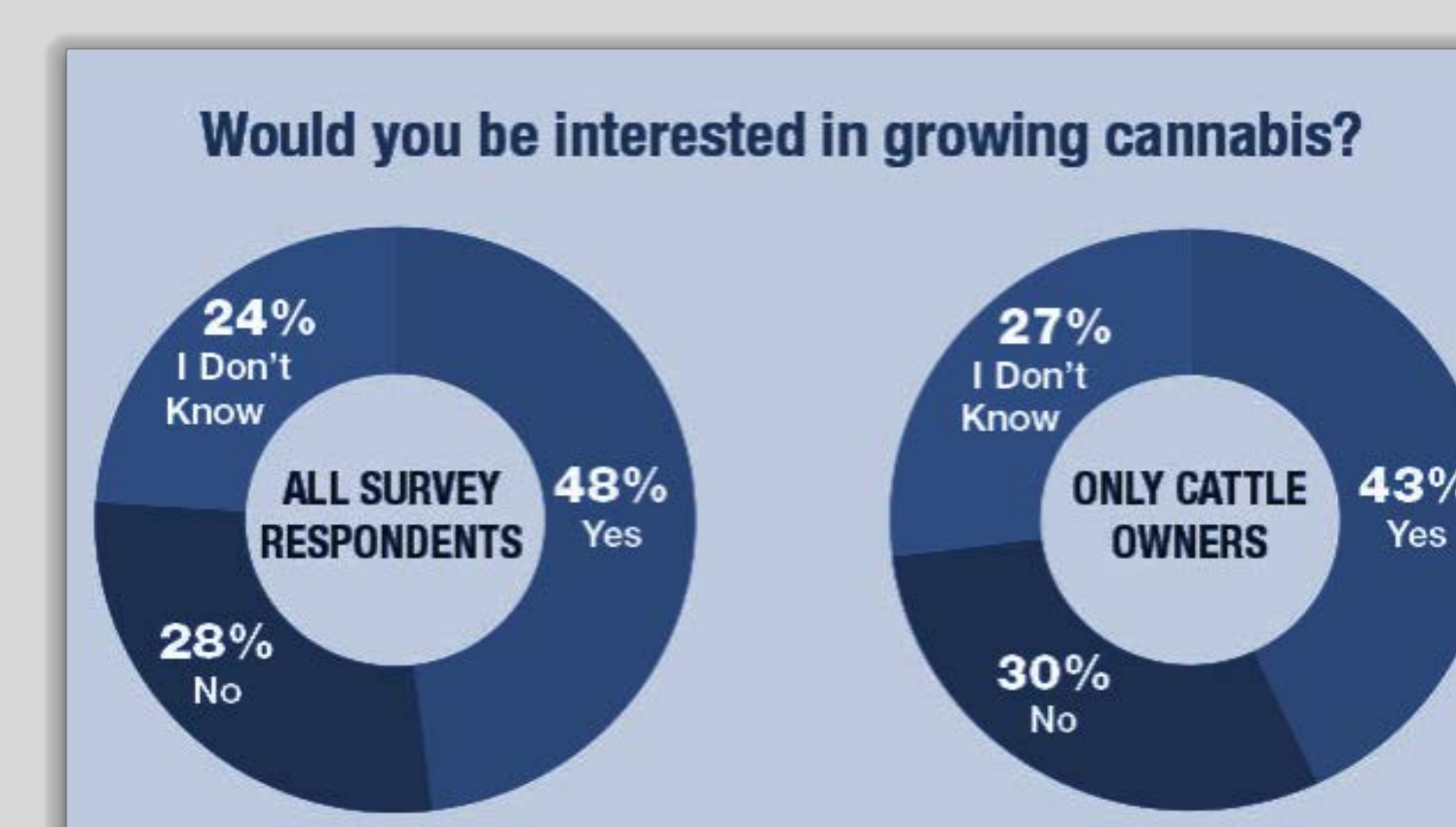
^cCalculated on the basis of the Canadian grading system, in which 1 = A, 2 = AA and 3 = AAA. In this study, 3.5, 5.4 and 42.1% of the steers graded A, AA and AAA, respectively.

Introduction and Background

For the uses of this review, hemp refers to *Cannabis sativa* L., the variety hemp that produces oil and a residual meal that is a potential livestock feedstuff. The *Cannabis sativa* L. used in these studies contain less than the legal limit 0.3% of delta9-tetrahydrocannabinol (THC), the chemical intoxicant found in marijuana. The 2018 Farm Bill removed industrial hemp from the list of United States controlled substances, making regulated hemp production legal within the United States. In order to make hemp oil and fiber processing viable, markets for the remaining meal must be found (Mustafa, A. F., McKinnon, J. J., & Christensen, D. A., 1999, 91). One potential use for this meal is as a livestock feed.

Perspective Two

Nutritional science is not the only defining factor in determining the future of hemp meal in livestock feed. Agriculturalists and consumers are socially biased on the topic of hemp production, which may prevent full utilization of the crop. In 2019, an online agricultural news agency surveyed farmers and ranchers about growing hemp in a study titled “Cannabis in U.S. Agriculture” (Henderson 2019). When asked if they would be interested in producing hemp, 48% of all respondents and 43% of respondents who owned cattle replied positively (Henderson, 2019). As an additive in livestock feed, 48% of respondents said they either strongly agreed or agreed that they would feed it to their animals, while 33% neither agreed or disagreed and 18% either disagreed or strongly disagreed (Henderson 2019). Farmers and ranchers were also asked if they believed it to be ethical to feed hemp products to livestock if THC could be found in the meat, and 58% responded that it would not be ethical (Henderson 2019). According to Henderson, a common theme in the study was of farmers saying things like “if I could be certain it was low in THC and it was more profitable (to grow) it would be okay” (2019) or “if it has uses, is okay for the environment, if there is a market, if I can make money, then yes” (2019) when asked if they would consider growing hemp.



While profits and revenues are the major factors for most farmers (Henderson, 2019), other agriculturalists are hesitant when it comes to the social and political aspects of hemp production. Brooks from Farm Journal wrote: Well, because of my experiences growing up, I've struggled with the idea of cannabis production of any kind...I know many of you have, too, because I've read your emails and listened to you on the phone. We know from Farm Journal surveys 56% of farmers believe there's a stigma to growing cannabis, yet 48% of farmers are interested in growing it. (2019)

The United States Secretary of Agriculture Sonny Perdue also seems hesitant on the subject of hemp production, especially as an animal feed. He has been quoted as saying:

Hemp in animal feed? I'm not aware of any uses of hemp in animal feed. I know there are other uses...But we're trying to determine really what those individual uses are...Feed, it possibly could be involved in there. That has not been one of the primary uses we've heard of. We hear a lot of industrial uses for it, but I think it remains to be seen if part of the product could be used in animal agriculture. (Stewart 2019)

Author's Perspective and Conclusion

There are true concerns about the long-term effects of hemp production, from the use of oil in humans to the use of meal in feedstuff. However, agriculturalists are working towards spending more time and resources on hemp research to mitigate these concerns. The current research points to the conclusion that hemp meal would be a valuable asset to the cattle industry. As a feed, it has the potential to increase rumination, support ruminant health, and increase protein in livestock diets. If hemp meal continues to prove to be of a nutritional value to livestock, the only barrier to widespread use will be that of public opinion. The court of public opinion is the largest obstacle the industry faces. However, current social trends towards “natural” products and medicines like hemp oil could ease the way for hemp legalization. If agriculturalists capitalize on this opportunity, it is possible that hemp meal could become as commonplace as soybean meal in livestock feed. Hemp production offers American agriculturalists a new and exciting avenue for further research into a potential livestock feedstuff. Agriculturalists must advocate with farmers, consumers, and legislators to increase awareness on the potential benefits of the product and reduce the stigma on hemp production.

Citation

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