

Die Nutzung von Pflanzenkohle in der Schweinemast

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Die Nutzung von Pflanzenkohle in der Schweinemast

Einsatz von Pflanzenkohle bei landwirtschaftlichen Nutztieren

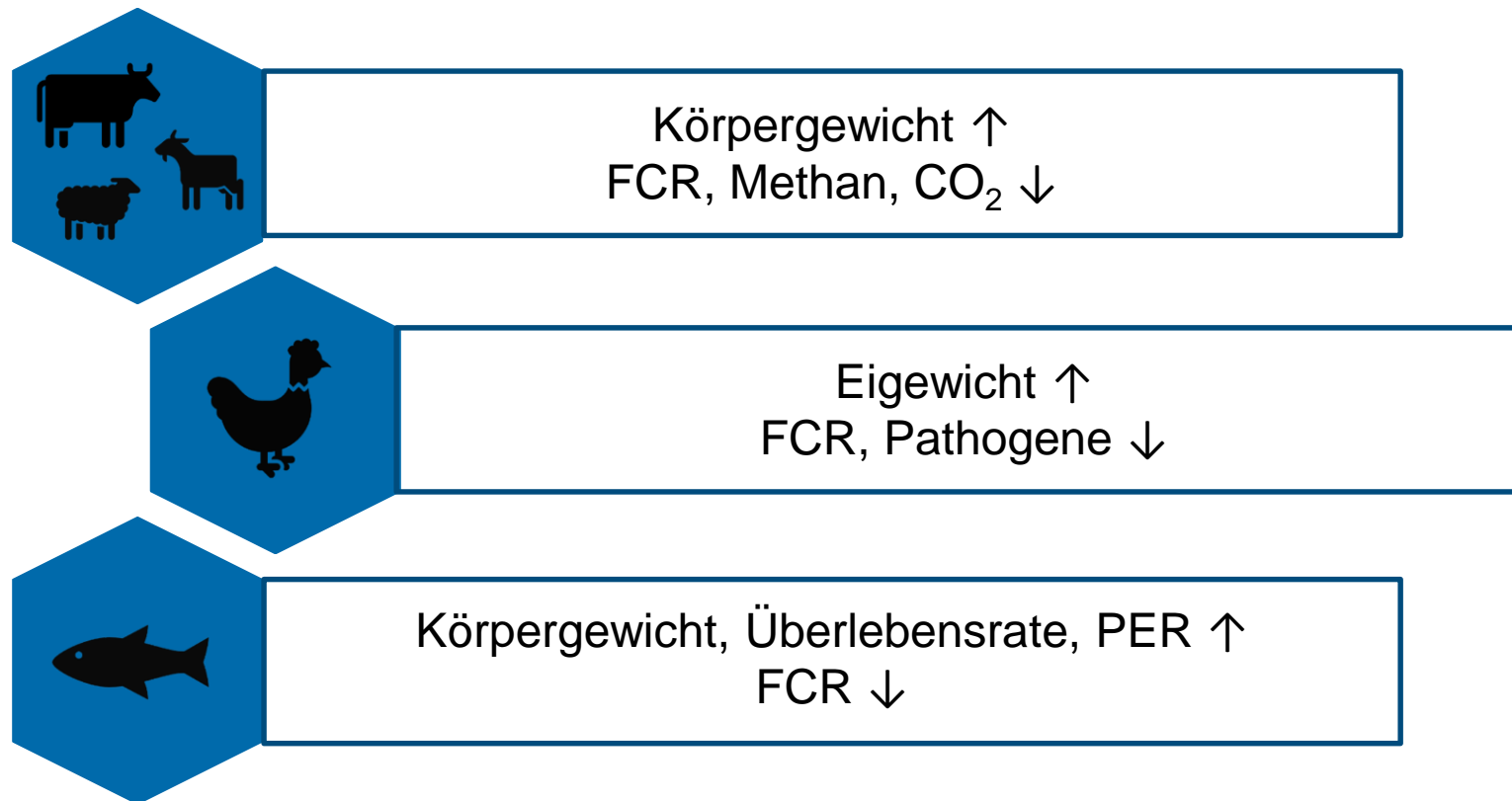


Abb. nach Man et al. (2020)

FCR, feed conversion ratio. PER, protein efficiency ratio.

Einsatz von Pflanzenkohle beim Schwein



Quelle	Einsatzmenge (in Futter-TS)	Ausgangsmaterial	Ergebnis
Chu et al. 2013a	0,3 %	Bambus	Fäkales Mikrobiom: Milchsäurebakterien ↑ Coliforme und Salmonellen ↓
Chu et al. 2013b	0,3 %	Bambus	Fettsäure-Muster: ungesättigte FS ↑, gesättigte FS ↓
Chu et al. 2013c	0,6 %	Bambus	Blutbild: AK-Titer, IgG ↑, LDH, Triglyzeride, Cortisol ↓
Kupper et al. 2015	3 %	k.A.	KGW-Zunahmen, FA, FCR =
Sivilai et al. 2018	1 %	Reisspreu	KGW-Zunahmen ↑, FCR ↓

↑ Zunahme, ↓ Abnahme, = keine Veränderung. AK, Antikörper. FA, Futteraufnahme. FCR, feed conversion ratio (Futteraufwand). IgG, Immunglobulin G. k.A., keine Angabe. KGW, Körpergewicht. TS, Trockensubstanz.

Forschungsprojekt

Pflanzenkohle als Futtermittelzusatz zur Reduktion der Skatol- und Indolkonzentration im Schweinefleisch (AiF 20221N)

Projekträger: Bundesministerium für Wirtschaft und Klimaschutz

Projektlaufzeit: 08.2018 – 04.2021



... ein Projekt der *Industriellen Gemeinschaftsforschung (IGF)*

gefördert durch/via



Das o. g. IGF-Vorhaben der Forschungsvereinigung Forschungskreis der Ernährungsindustrie e. V. (FEI), Godesberger Allee 142-148, 53175 Bonn, wird/wurde über die AiF im Rahmen des Programms zur Förderung der Industriellen Gemeinschaftsforschung (IGF) vom Bundesministerium für Wirtschaft und Energie aufgrund eines Beschlusses des Deutschen Bundestages gefördert.

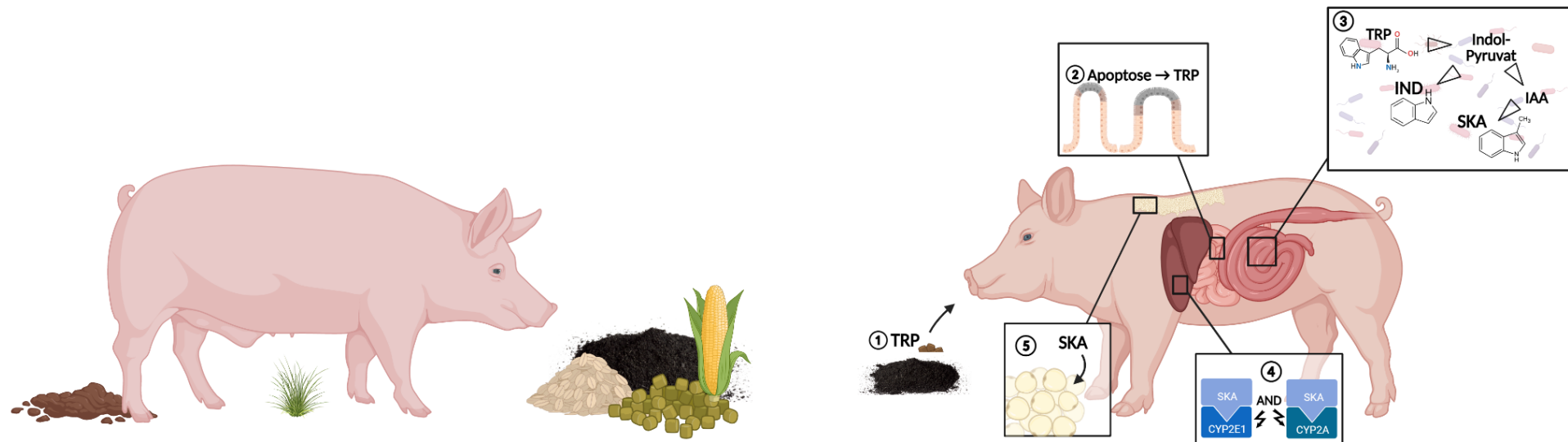
Hintergrund

- Immer mehr Länder weltweit verbieten aus Gründen des Tierschutzes die Ferkelkastration ohne Betäubung oder Schmerzlinderung (BGBl. I 2018, Lin-Schilstra et al. 2021)
- Alternativen zur betäubungslosen Ferkelkastration zur Vermeidung von Ebergeruch (Bonneau et al. 2019):
 - Immunokastration
 - Schlachtung intakter Eber vor Beginn der Geschlechtsreife
 - Chirurgische Kastration unter Vollnarkose
- Bei intakten Ebern ist das Risiko von Ebergeruch auch bei vorzeitiger Schlachtung noch gegeben
→ nutritive Ansätze zur Verringerung der Ebergeruchskomponenten (Skatol und Indol) (Wesoly und Weiler 2012)

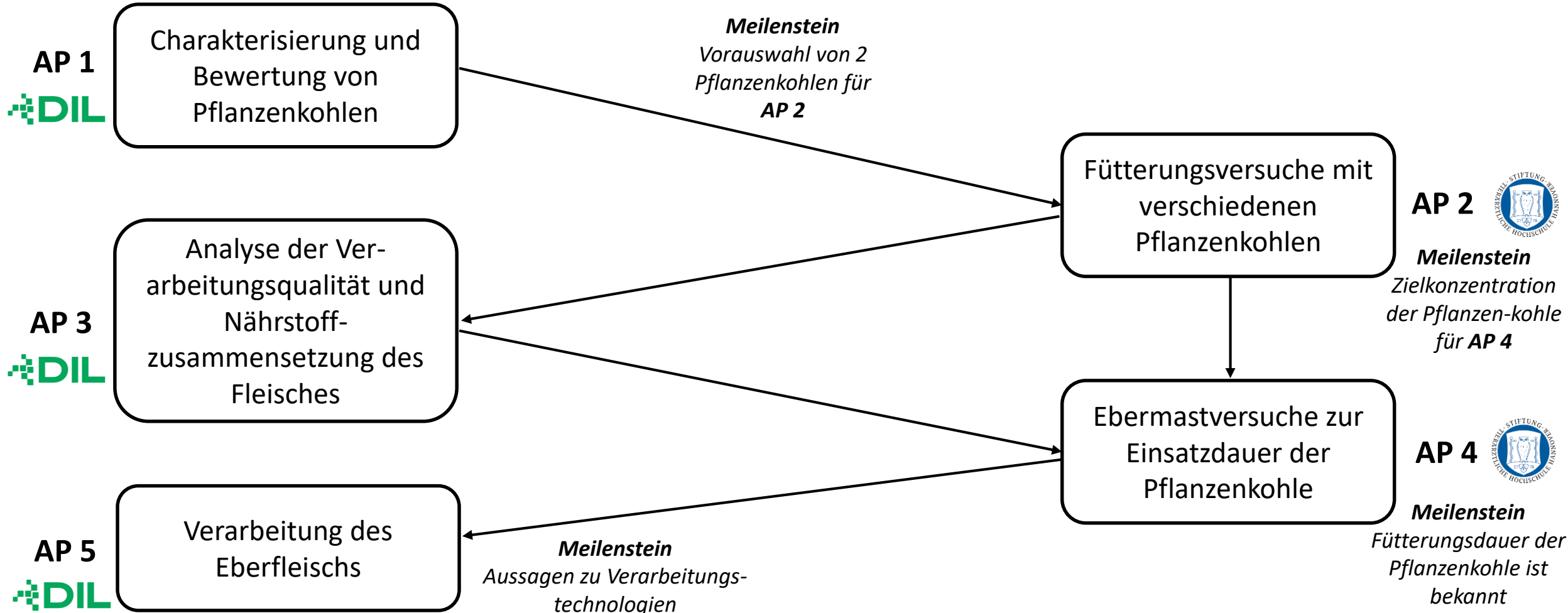
Pflanzenkohle als Futtermittelzusatz zur Reduktion der Skatol- und Indolkonzentration im Schweinefleisch (AiF 20221N)

Ziel der Studie

Untersuchung von Pflanzenkohle als intestinales Bindemittel zur Reduktion der Skatol- und Indolkonzentrationen in Kot und Plasma von Endmastebern



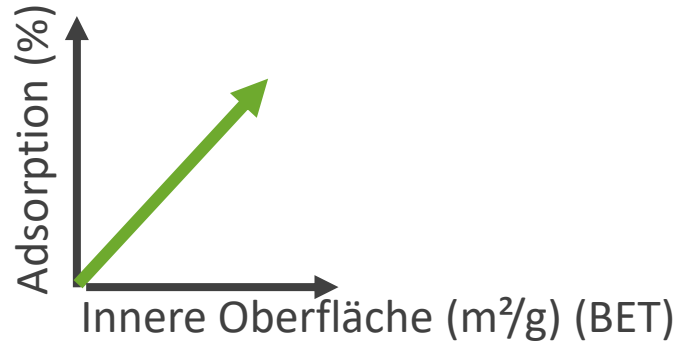
Pflanzkohle als Futtermittelzusatz zur Reduktion der Skatol- und Indolkonzentration im Schweinefleisch (AiF 20221N)



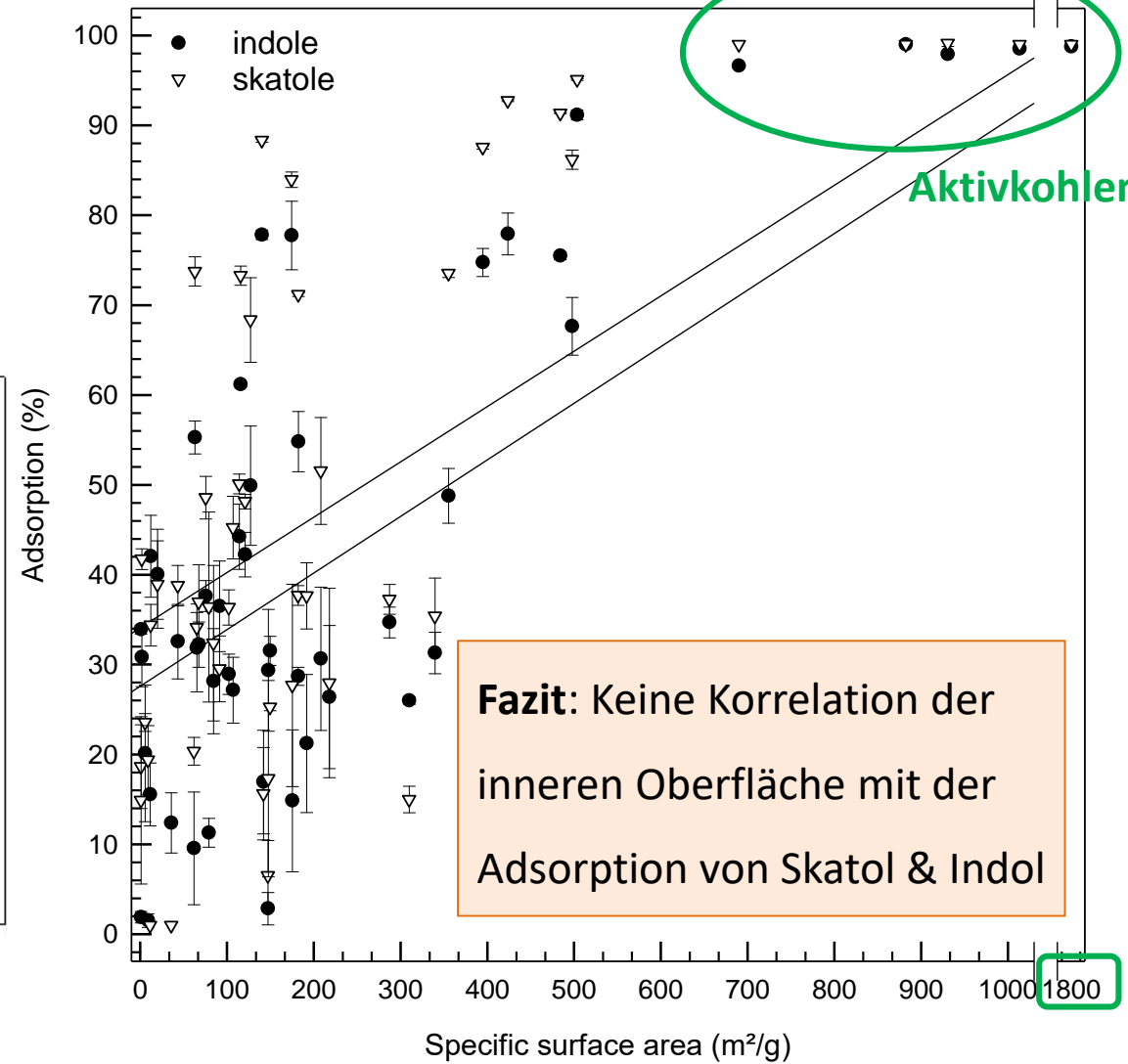
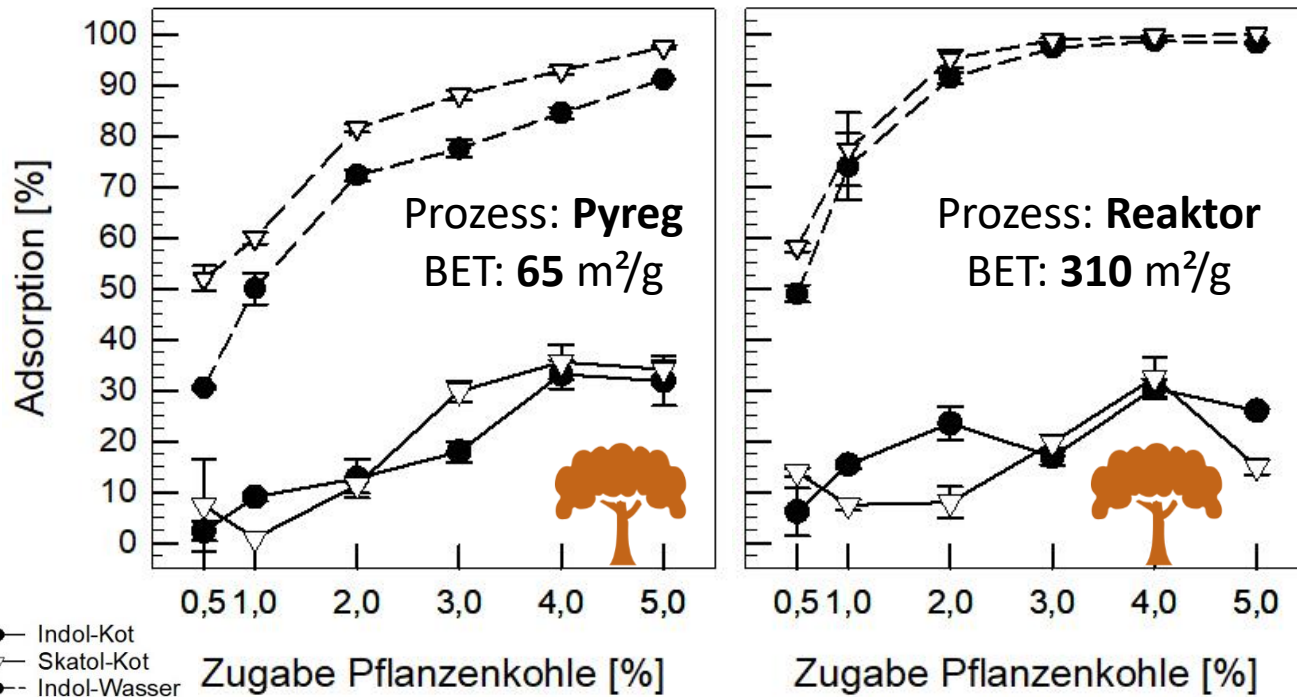
Pflanzkohle als Futtermittelzusatz zur Reduktion der Skatol- und Indolkonzentration im Schweinefleisch (AiF 20221N)

- Charakterisierung von 50 Pflanzkohlen, davon 7 als Futtermittel zugelassen

- **Hypothese:**



- **Ergebnis:**



● Indol-Kot
 ▼ Skatol-Kot
 ● Indol-Wasser
 ▼ Skatol-Wasser

Fazit: Keine Korrelation der inneren Oberfläche mit der Adsorption von Skatol & Indol

Erkenntnisstand nach Fütterungsversuchen mit vers. PK

- **Keine zufriedenstellende Reduktion der Skatol- und Indolgehalte** in den untersuchten Matrizen (Blut, Kot)
- **Keine negativen Effekte auf Leistungsparameter** (Futterraufnahme, Körpermassenzunahme und Futterraufwand)
- **Steigerung der Verdaulichkeit** der Trockensubstanz, der organischen Substanz sowie von Rohfett, Rohprotein (nur PK2 signifikant), Rohfaser und der N-freien Extraktstoffe durch 2 % PK
- **Erhöhung des Trockensubstanzgehalt im Kot** durch 2 % PK1 und PK2 sowie 3 % PK2, nicht aber durch 1 % PK2 (in Dissertationsschrift Schubert enthalten)
- Für weitere Versuche Einsatz von **Pflanzenkohle 2** in zweiprozentiger Konzentration
- **Hypothese: Pflanzenkohle wird im Dünndarm bereits beladen und kann im Dickdarm keine weiteren Substanzen mehr adsorbieren**



Effect of Two Different Biochars as a Component of Compound Feed on Nutrient Digestibility and Performance Parameters in Growing Pigs

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The objective of this study was to examine two different biochars as a component of compound feed regarding their effects on nutrient digestibility and performance parameters in growing pigs. A total of 18 male, intact piglets ($N = 18$) with 26 days of age and an initial bodyweight of 6.88 kg were divided into three homogeneous groups of six animals each ($n = 6$). Treatments were control (CON, no addition of biochar), 2% biochar 1 (BC 1, diet containing 2% biochar 1), and 2% biochar 2 (BC 2, diet containing 2% biochar 2). Before the start of the trials, the biochars were characterized regarding Brunnauer-Emmet-Teller (BET) surface area, surface energy, humidity, and ash content. During the first trial (weeks 1–6) a 3×3 Latin square was used to determine the apparent total tract digestibility (ATTD) of all three feeds in each animal ($N = 54$, $n = 18$). By start of the second trial on day 42, three new homogeneous groups were formed with two animals from each of the previous groups. Each group received one of the three diets for 4 weeks. In the first trial, the ATTD of dry matter, organic matter, ether extract, crude fiber, and N-free extract was higher ($p < 0.05$) in pigs fed the biochar diets (BC1 and BC2) than in those animals fed the control diet. The greatest difference was found for ATTD of crude fiber, which was increased by 19.8 and 23.8%, respectively (CON: $30.8^{\text{b}} \pm 13.4\%$; BC 1: $38.4^{\text{a}} \pm 8.2\%$; BC 2: $40.4^{\text{a}} \pm 12.2\%$). ATTD of crude protein was only higher in BC 2 compared to CON (CON: $81.0^{\text{b}} \pm 4.1\%$; BC 1: $82.4^{\text{bd}} \pm 3.6\%$; BC 2: $84.2^{\text{a}} \pm 3.4\%$). In both trials, the different treatments revealed no effects on ADFI, ADWG or G:F ($p > 0.05$). The results indicate that no negative effects can be expected when 2% biochar is included in the feed for growing pigs.

Keywords: biochar, nutrient digestibility, piglet, performance parameter, feed efficiency

INTRODUCTION

In order to withstand economic pressure, modern livestock farming must become increasingly efficient (De Clercq et al., 2018; Isenmeyer, 2020). Simultaneously, society as well as politics demand a change toward sustainable agriculture (Darnhofer et al., 2016; Franková and Cattaneo, 2018). These problems are a burden not only on agriculture in general but also on pork production in

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Erkenntnisstand nach Coatingversuchen

- Coating der Pflanzenkohle verzögert Freisetzung der Adsorptionsfähigkeit der Pflanzenkohle bis zum Dickdarm (bis Lipasen den „Fett-Mantel“ abgebaut haben); bestätigt durch:
 - *In vitro*-Versuch: „natur“ und „ummantelt“ Pflanzenkohle in Wasser und Caecum und Colon Chymus
 - *In vivo*-Versuch: 6 Ferkel Kontrolle vs. 6 Ferkel „natur“ vs. 6 Ferkel „ummantelt“ Pflanzenkohle → Untersuchung des Caecum und Colon Chymus
- Signifikante Reduktion von Skatol und Indol durch Pflanzenkohle, vor allem durch ummantelte Pflanzenkohle
- Coating der Pflanzenkohle für Fütterungsversuche mit Ebern



Communication

Preliminary Test of the Reduction Capacity for the Intestinal Adsorption of Skatole and Indole in Weaning Piglets by Pure and Coated Charcoal

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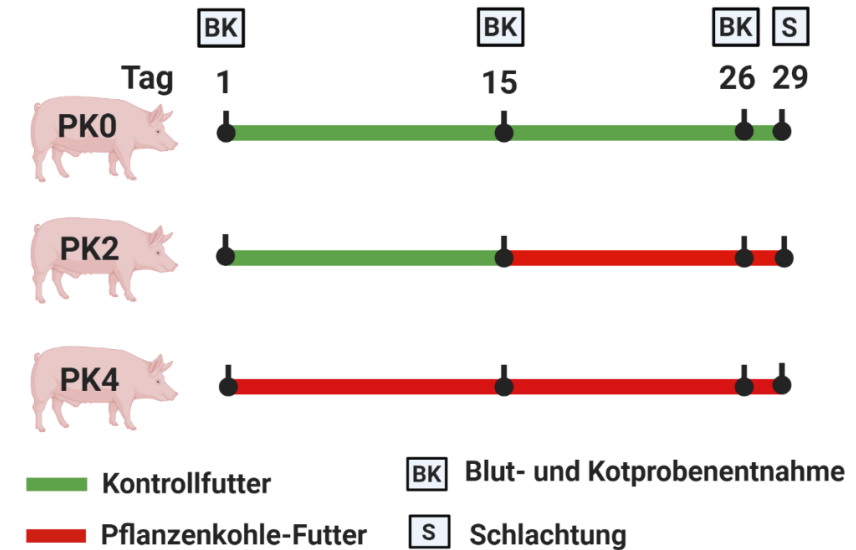
Simple Summary: To suppress or prevent boar taint, many strategies are available, e.g., surgical or immunocastration or different housing and feeding conditions. In Germany, male piglets may no longer be castrated without anesthesia until the 7th day of life for animal welfare reasons. The aim of this study was to reduce skatole and indole, two of the boar taint-causing substances, by the feeding of charcoal. A fat coating applied on charcoal could delay the unspecific adsorption of charcoal until entry to the large intestine where skatole and indole should be adsorbed since the fat coating is digested during its passage through the small intestine. In total, 18 piglets were divided into three feeding groups and were fed for 19 days with the control feed or with the control feed plus 2% charcoal or plus 4% charcoal coated with a fat layer. The skatole and indole concentrations were analyzed in chyme retrieved from the colon and caecum as these substances need to be adsorbed by charcoal in the intestine to prevent resorption into the bloodstream and accumulation in fat. The reduction in skatole and indole contents underlines charcoal's adsorption capacity. The adsorption capacity was higher when the charcoal was coated. As charcoal reduced skatole and indole, feeding trials with adult boars are needed to observe the status of boar taint substances at the day of slaughter.

Abstract: To reduce the risk of boar taint, intact male piglets are immuno- or surgically castrated. One alternative is reducing skatole by adding skatole reducing or adsorbing substances to the boars' diet. Charcoal with a high capacity for adsorbing skatole and indole in vitro (tested before, data not shown) was fed to the boars to test the hypothesis that a fat coating prevents the unspecific adsorption of charcoal before entry into the large intestine while increasing skatole adsorption. Twelve male and six female weaning piglets with initial body weights of 7.74 ± 0.75 kg were fed for 18 (or 19) days with either 2% pure (untreated) charcoal or 4% coated (50% charcoal + 50% fat-coating) charcoal or no charcoal. After euthanasia, skatole and indole were quantified in caecum and colon chyme. Skatole and indole contents in caecum chyme were significantly lower ($p < 0.05$) in the group fed with coated charcoal ($33 \pm 4.2, 7 \pm 2.8 \mu\text{g}/\text{g}_{\text{DM}}$, respectively) than in the group fed with pure charcoal ($51 \pm 7.3, 14 \pm 3.0 \mu\text{g}/\text{g}_{\text{DM}}$) or with no charcoal ($73 \pm 12.6, 15 \pm 1.7 \mu\text{g}/\text{g}_{\text{DM}}$). Similar effects were obvious for colon chyme. The results indicate that a fat coating of charcoal might prevent unspecific adsorption in the small intestine and might consequently lead to a higher adsorption capacity for skatole and indole in the large intestine, as skatole and indole concentrations in the chyme of caecum and colon were approximately 50% lower in the piglets who received coated charcoal.

Keywords: boar taint; charcoal; fat coating; skatole; indole

Versuchsaufbau

- Einteilung der Eber in 3 Gruppen:
 - Kein Zusatz von Pflanzenkohle (PK) = Kontrolle (PK0)
 - Zusatz von PK in den letzten 2 Wochen vor Schlachtung (PK2)
 - Zusatz von PK in den letzten 4 Wochen vor Schlachtung (PK4)
- Pflanzenkohle aus Eichenholz, 1:1 (w/w) mit pflanzlichem Fett ummantelt und pelletiert
- Konzentration der Pflanzenkohle im Futter 2 % (entspr. 4 % PK-Fett-Pellets)
- Probensammlung (Blut, Kot) an Tag 1, 15 und 26, Schlachtung an Tag 28
- Wöchentliche Erfassung von KGW und FA



Erkenntnisstand nach Ebermastversuchen

- Keine Unterschiede zwischen den Fütterungsgruppen bezogen auf die Skatol- und Indolgehalte in Kot und Plasma nachweisbar
- Die Summe der Gehalte an Skatol und Indol im Kot war bei Gruppe PK2 am Versuchsende signifikant niedriger als am Versuchsanfang
- Verbesserung der Kotqualität durch Erhöhung des TS-Gehalts
- Keine Beeinträchtigung von Futteraufnahme, Körpermassenzunahme und Futteraufwand
- Maschinell verarbeitetes Pflanzenfett möglicherweise nicht komplett verdaut (Fettpartikel im Kot beider Fütterungsgruppen sichtbar)



Article Evaluation of Coated Biochar as an Intestinal Binding Agent for Skatole and Indole in Male Intact Finishing Pigs

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Simple Summary: Public awareness of animal welfare in livestock farming continues to grow all over the world, especially in Central Europe as well as in Australia and Northern America. Consequently, the ban on piglet castration without anaesthesia comes into force in Germany and France in 2021 and other European countries such as Norway, the Netherlands, Switzerland and Sweden have taken legislative actions against piglet castration without pain relief earlier. Hence, alternatives have to be established that prevent the occurrence of boar taint in male pigs. The aim of the present study was to examine the effect of dietary biochar on boar taint compounds (skatole and indole) in faeces and plasma as well as on performance parameters. The biochar was added to the feed whether two or four weeks before slaughter. Animals that received biochar during the last two weeks before slaughter had lower skatole concentrations in faeces at the end of the trial than at the beginning, whereas these results could not be confirmed when animals received biochar for four weeks. Nevertheless, the faeces was drier when animals were fed biochar and performance was not affected. Results indicate that more research is necessary to better understand the nonspecific adsorption capacity of biochar.

Abstract: The ban on piglet castration without anaesthesia poses a challenge for the meat industry since alternatives ensuring the production of flawless pork have to be established. The aim of this study was to evaluate the effects of biochar on skatole and indole concentration in faeces and plasma on a small scale in finishing boars to prove whether biochar was suitable for use in commercial pork production. Moreover, it was investigated whether biochar affects faecal properties or the performance. For a four-week trial period, 54 boars (bodyweight 97.2 ± 6.88 kg) were divided into three groups. The control (BC0) received no dietary biochar, one group received a diet containing 4% coated biochar (corresponding to 2% pure biochar) for the final two experimental weeks (BC2), and another group for the entire four weeks (BC4), respectively, prior to slaughter. Skatole and indole concentrations were measured in faeces and plasma at the beginning, in the middle and at the end of the trial. Mean skatole concentrations did not differ between groups, but in BC2 faecal skatole was significantly decreased at day 26, whereas in BC4 initial and final faecal skatole levels did not differ. At day 15 and 26, the faecal dry matter content was significantly higher in pigs fed the biochar diet ($p < 0.05$).

Keywords: skatole; indole; boar; boar taint; piglet castration; biochar; plantcoke



Citation: Schubert, D.C.; Chuppava, B.; Witte, F.; Terjung, N.; Visscher, C. Evaluation of Coated Biochar as an Intestinal Binding Agent for Skatole and Indole in Male Intact Finishing Pigs. *Animals* **2021**, *11*, 760. <https://doi.org/10.3390/ani11030760>

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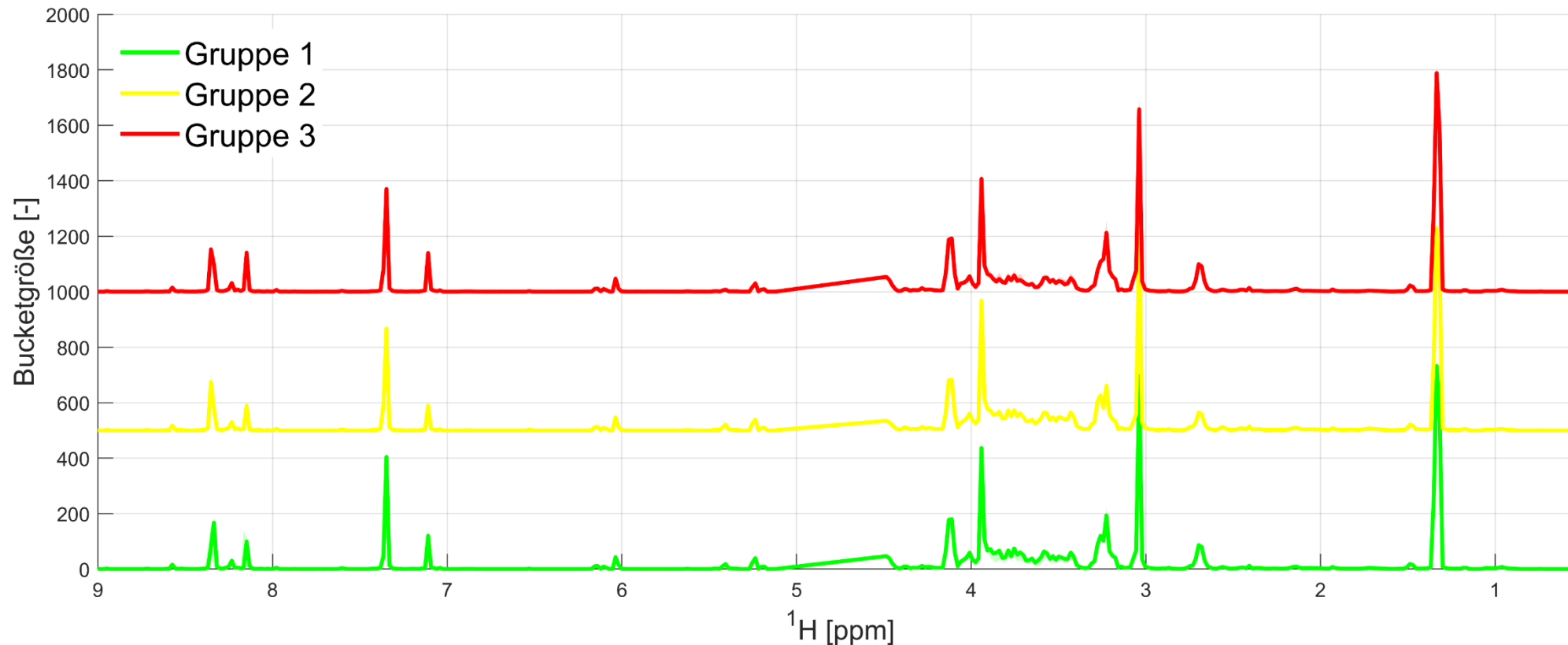
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– NMR-Analytik vom Eber-Fleisch verschiedener Fütterungsgruppen



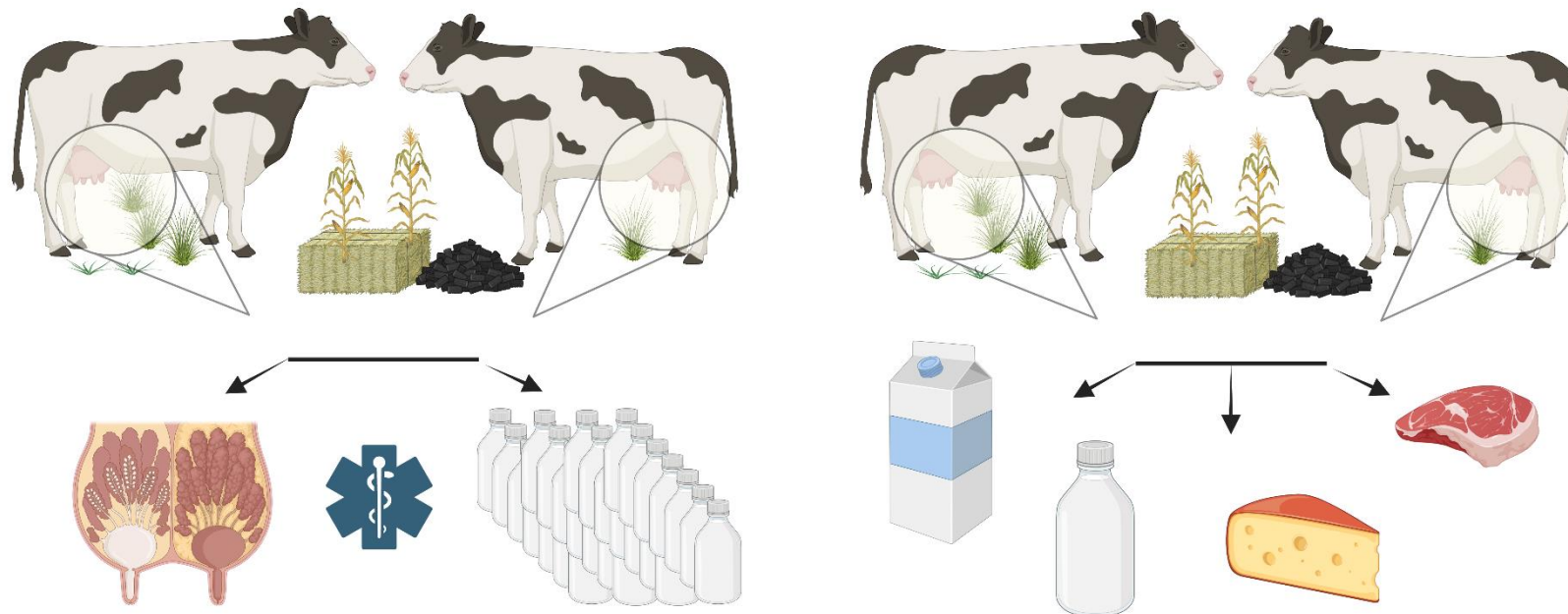
– Keine Unterschiede zwischen Spektren → Kein Unterschied in den Metaboliten durch die Fütterung von Pflanzenkohle

Forschungsprojekte

Pflanzenkohle als Fütterungszusatz zur Verbesserung der Milchqualität durch Förderung der Tiergesundheit (AiF 21795N)

Projekträger: Bundesministerium für Wirtschaft und Klimaschutz

Projektlaufzeit: 04.2021 – 03.2024



Einsatz von Pflanzenkohle in der Tierernährung

Optimierung von Pflanzenkohleherstellung und -konditionierung unter Einbindung der Tierhaltung für eine ökologisch wirksame C-Sequestrierung in der flächengebundenen Landwirtschaft der Zukunft

Arbeitsziele:

1. Herstellung von Pflanzenkohlen aus möglichst nährstoffarmen, aber C-reichen Nebenprodukten aus dem Pflanzenbau oder anderen zugelassen Rohstoffen
2. Beladung dieser Pflanzenkohle mit phosphorbinden Mikroorganismen zur Bindung leicht wasserlöslicher Phosphorverbindungen
3. Prüfung des Pflanzenkohleeinsatzes im Tier im Vergleich zur Anwendung direkt in der Gülle, um Effekte auf die Löslichkeit von Nährstoffen (insbes. P) zu bestimmen

CAVE: Aufgrund des Urteils des Bundesverfassungsgericht und Verortung der Förderinitiative „Humus“ im Sondervermögen des „Klima- und Transformationsfonds“ (KTF) dürfen aktuell keine Zuwendungen beschieden werden (Mitteilung BLE aus KW 47)

Vielen Dank für Ihr
Interesse!

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