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Animal Feed Science and Technology

Volume 285, March 2022, 115240

Association between yeast product feeding and milk production of lactating dairy cows: Multilevel meta-analysis and meta-regression

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Highlights

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YP supplementation was associated with increased MY and milk components but without any increase in DMI.

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The involvement of DMI in the relation between YP and MY is a point that has been debated with conflicting literature.

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The variable response to YP supplementation is a result of external factors such as diet characteristics (ADF, CP and starch).

Abstract

To provide an overview of the association between commercially available yeast product (YP) supplementation and milk yield (MY) in lactating dairy cows, multilevel meta-analyses were performed on 99 trials from 49 peer-reviewed studies. Associations were evaluated using random effects models to examine the standardized mean difference (SMD) between the YP and control treatments. Associations were also quantified using the weighted mean difference (WMD). YP supplementation was associated with increased milk yield (+ 0.69 kg/d), [milk fat](#) content (+ 0.06%), [milk fat yield](#) (+ 0.04 kg/d) and [milk protein yield](#) (+ 0.02 kg/d). A positive association between YP and MY was not observed in primiparous cows during mid- and [late lactation](#) or in cows fed a high [neutral detergent fiber](#) diet. The improvement of MY in cases of YP supplementation was higher if YP supplementation started before calving (+ 0.79 kg/d) compared to after calving. The multivariate analyses showed that YP supplementation was associated with an increase in MY but not with an increase in [dry matter intake](#) (DMI). This provides strong evidence that greater milk production observed in supplemented cows is not a result of increased DMI.

Introduction

The influence of yeast products (YP) based on *Saccharomyces cerevisiae* (*S. cerevisiae*) supplementation on dairy cow performance has been studied for decades. Despite this extensive research, the results have been very inconsistent. Improvements in both milk production and dry matter intake (DMI) when YP were fed have been reported in some studies (Dann et al., 2000, Moallem et al., 2009, Ramsing et al., 2009, Salvati et al., 2015). Other studies have observed increased milk production without any increase in DMI (Yuan et al., 2015, Zhu et al., 2016, Muñoz et al., 2017, Shi et al., 2019, Perdomo et al., 2020) or no significant effect of YP supplements on production or on DMI (Shwartz et al., 2009, Ferraretto et al., 2012, Dias et al., 2018c, Olagaray et al., 2019). In previous meta-analyses and multiple-study analyses (Sauvant et al., 2004, de Ondarza et al., 2010, Poppy et al., 2012), the milk response to YP supplements was positive, whereas DMI responses were variable. This is all the more surprising because several authors observed the positive effect of YP on MY via an increase in DMI (Allen and Ying, 2012, Poppy et al., 2012, Alnaimy Mostafa Habeeb, 2017), while others linked the positive responses to YP on MY to an improvement in ruminal metabolism (Malekkhahi et al., 2016, Oh et al., 2019) and to stabilized microbial communities in the rumen (Bach et al., 2007), which may lead to increased feed efficiency (Schingoethe et al., 2004, de Ondarza et al., 2010).

Variation in responses to YP supplementation is not well understood, and uncertainties remain regarding whether contextual factors can modulate the response to supplementing YP, such as stage of lactation (Dann et al., 2000, Lehloenya et al., 2008), parity (McGilliard and Stallings, 1998, Robinson and Garrett, 1999), type of YP (Alshaikh et al., 2002), period of treatment, feeding behavior (DeVries and Chevaux, 2014, Yuan et al., 2015, Dias et al., 2018a, Perdomo et al., 2020), diet characteristics (Ferraretto et al., 2012), and the prevailing management or experimental conditions (Dann et al., 2000, Erasmus et al., 2005).

Although there have been previous meta-analyses studying the association between YP supplementation and lactation performance (Sauvant et al., 2004, de Ondarza et al., 2010, Poppy et al., 2012), we believe that a new meta-analytical investigation remains relevant for the following reasons: (1) previous meta-analyses have not taken account of the hierarchical structure models; (2) a large number of new studies have been published in recent years; and (3) we include here factor-analytic methods (i.e. meta-regression).

This meta-analysis aims therefore to quantify the association between YP supplementation and lactation performance, particularly MY, in dairy cows and to identify factors affecting this association.

Using multivariate meta-analysis, we also aimed to address whether the association between YP and MY is modulated by DMI.

Section snippets

Search Strategy

The systematic review was performed in accordance with the PRISMA guidelines (Moher et al., 2009). Fig. 1 outlines the search strategy used.

Literature Search

Relevant papers were identified by searching for peer-reviewed manuscripts that were published in English by utilizing three search engines in April 2020 [PubMed (<https://www.ncbi.nlm.nih.gov/pubmed>), ScienceDirect (<http://www.sciencedirect.com/>), and Google Scholar (<http://www.scholar.google.com/>)] and using search terms including various combinations of

Results

A total of forty-nine publications met the inclusion criteria for the meta-analysis, of which 99 separate comparisons (trials) were reported. A description of the included publications is presented in Supplemental Table S1. Studies originating largely from North America and Europe and YP used in studies were from at least 12 different commercial yeast products. Publications were excluded if they included only positive treatment control groups; used crossover designs; lack of randomization

Discussion

This meta-analysis investigated the association between YP supplementation and DMI, milk production and composition. A particular strength of this analysis was the power derived from the number and quality of the included studies. Indeed, we used only data from high-quality published studies in peer-reviewed journals, and industry reports were excluded. One important bias in the meta-analysis is primary study bias. Not including low-quality studies (nonrandomized studies) and gray literature

Conclusion

This meta-analysis demonstrated that YP treatment resulted in positive but small increases in MY and milk components. The improvement observed in MY was not a result of increased DMI. Cows were more responsive to YP treatment if the treatment started before calving and when fed a low-ADF associated with high-starch or low-CP diets. Further meta-analytical

investigations of the association between YP and the ruminal microbial activity, fermentation patterns and/or rumen function variables are

Declaration of Competing Interest

The authors declare no conflict of interest.

Acknowledgements

All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are, named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.

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