

Abstract

Can Arginine Help to Improve Milk Supply in Humans? It Does in Cows[†]

Luoyang Ding^{1,2,*}, Yizhao Shen¹, Tianyou Wu¹, Lianmin Chen¹, Juan J. Loor³, Shane K. Maloney⁴, Mengzhi Wang¹ and Dominique Blache^{1,2}

¹ College of Animal Science and Technology, Yangzhou University, Yangzhou 225009, China; shenyizhao@163.com (Y.S.); 18752540287@163.com (T.W.); lianminchen@yeah.net (L.C.); mzwang@yzu.edu.cn (M.W.); dominique.blache@uwa.edu.au (D.B.)

² School of Agriculture and Environment, The University of Western Australia, Crawley, WA 6009, Australia

³ Department of Animal Sciences and Division of Nutritional Sciences, University of Illinois, Urbana, IL 61801, USA; jloor@illinois.edu

⁴ School of Human Sciences, The University of Western Australia, Crawley, WA 6009, Australia; shane.maloney@uwa.edu.au

* Correspondence: luoyang.ding@uwa.edu.au

[†] Presented at the Australian Breastfeeding + Lactation Research and Science Translation Conference (ABREAST Conference 2023), Perth, Australia, 10 November 2023.

Keywords: arginine; milk production; nutrients utilization efficiency; AMP-activated protein kinase

Arginine can be metabolized into nitric oxide, polyamine, creatine, or agmatine, and each of those metabolites has several biological functions. Arginine has been shown to play an important role in the regulation of metabolism, immune function, and hormone secretion in mammals. The present study tested the hypothesis that arginine could be beneficial to milk supply by enhancing the efficiency of nutrient utilization. Using lactating cows as the study model, we found that supplementation with arginine via a jugular vein increased the daily milk yield, milk protein yield, and milk fat yield. The supplementation had no effect on the feed intake or the digestibility of dry matter, crude protein, or ether extract. The urea nitrogen in serum, urine, and milk was lower in cows that were infused with arginine, indicating a better utilization of nitrogen in the cows that were supplied with extra arginine. The underlying cause of these changes may have been the elevated serum nitric oxide (a potent vasorelaxant in mammals), stimulating mammary blood flow and the supply of amino acids, fatty acids (FAs), and glucose to the mammary gland in the cows that were infused with arginine. Furthermore, the expression of genes that code for amino acid transporters (*SLC7A2* and *SLC7A8*), and enzymes involved in the biosynthesis of FA (*ACACA*) and triglycerides (*SCD*), and FA desaturation (*DGAT1*) were higher in the mammary gland of cows that were infused with arginine. As a result, the de novo synthesis of FA and casein in the mammary gland were enhanced in the cows that were supplied with extra arginine. Taken together, the available data suggest that the positive effect of arginine on milk supply was caused by a combination of more blood flow via nitric oxide and a direct effect of arginine on the expression of genes that code for proteins that are involved in the synthesis of milk protein and milk fat.

Author Contributions: Conceptualization, L.D., M.W. and D.B.; methodology, L.D., Y.S., T.W. and L.C.; formal analysis, L.D., D.B. and S.K.M.; investigation, L.D., Y.S. and T.W.; resources, J.J.L.; writing—original draft preparation, L.D.; writing—review and editing, M.W., D.B. and S.K.M.; supervision, M.W. and D.B.; project administration, L.D.; funding acquisition, M.W. All authors have read and agreed to the published version of the manuscript.

Funding: This study was funded by the National Key Research and Development Program of China (2018YFD0502100) and the China Scholarship Council—The University of Western Australia Joint



Citation: Ding, L.; Shen, Y.; Wu, T.; Chen, L.; Loor, J.J.; Maloney, S.K.; Wang, M.; Blache, D. Can Arginine Help to Improve Milk Supply in Humans? It Does in Cows. *Proceedings* **2023**, *93*, 8. <https://doi.org/10.3390/proceedings2023093008>

Academic Editors: Donna T. Geddes and Zoya Gridneva

Published: 20 December 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Scholarship (201708320259). The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Institutional Review Board Statement: All the procedures for the treatment and care of experimental animals were approved by the Yangzhou University Animal Care and Use Committee (EA/201900011) and followed the established guidelines for animal welfare.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data analyzed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: The authors of this manuscript thank the staff at Experimental Farm of Yangzhou University (Yangzhou, Jiangsu, China) for their support in taking care of the animals.

Conflicts of Interest: The authors declare no conflicts of interest.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.