Final report

for the CORE Organic Cofund funded project

"*Promoting young stock and cow health and welfare by natural feeding systems-ProYoungStock*"

Period covered: 01.04.2018 to 30.09.2021

Index

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Project period: December 2016 - May 2022

1. General information

1.1 Project information

Project information			
Project acronym	ProYoungStock	**Project ID**	1916
Project title	Promoting young stock and cow health and welfare by natural feeding systems		
Project website	www.proyoungstock.net, https://projects.au.dk/coreorganiccofund/core-organic-cofund-projects/proyoungstock/		
Details of the project coordinator			
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Institution	Research Institute of Organic Agriculture	**Country**	Switzerland
Start of project	01.04.2018	**End date of project**	30.03.2021
Duration in months	**42**	**New end date in case of a project extension due to COVID-19**	30.9.2021

1.2 Consortium

Partner no.	Country	Institution/ organisation name	Type of institution/ organisation[1)]	Functions[2)]	Involved in WPs	Contact person[3)]
01	CH	Research Institute of Organic Agriculture (FiBL)	Private research centre	PC, WPL, P	1,2,3,6	Anet Spengler Neff & Anna Bieber anet.spengler@fibl.org anna.bieber@fibl.org
02	DE	University of Kassel (UniKassel)	University	WPL, P	1,3,4,6	Ute Knierim & Silvia Ivemeyer, uknierim@uni-kassel.de; ivemeyer@uni-kassel.de
03	PL	Institute of Genetics and Animal Biotechnology (IGBZPAN)	Non-profit organisation	P	1,2,3,6	Tomasz Sakowski, t.sakowski@igbzpan.pl
04	SI	Slovenian Holstein Association (HF-SLO)	Non-governmental organisation	P	1,2,4,6	Marija Klopčič, marija.Klopcic@bf.uni-lj.si
05	SE	Swedish University of Agricultural Sciences (SLU)	University	WPL, P	1,2,6	Karin Alvåsen & Nils Fall, karin.alvasen@slu.se , nils.fall@slu.se
06	AU	University of Natural Resources and Life Sciences Vienna - Department of Sustainable Agricultural Systems - Division of Livestock Sciences (BOKU)	University	WPL, P	1,3,4,6	Christoph Winckler & Birgit Fuerst-Waltl, christoph.winckler@boku.ac.at, birgit.fuerst-waltl@boku.ac.at
07	FR	The Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement (INRAE)	A Public Scientific and Technical Research Establishment	WPL, P	1,2,4,5,6	Bruno Martin, Dominique Pomies, Vincent Niderkorn, bruno.martin@inrae.fr, dominique.pomies@inrae.fr , vincent.niderkorn@inrae.fr
08	IT	University of Catania (UCat)	University	WPL, P	1,3,4,5,6	Alessandro Priolo, Giuseppe Luciano, Ruggero Menci, a.priolo@unict.it; giuseppe.luciano@unict.it; ruggero.menci@unict.it

1) University, Public research centre, Private research centre, Company, Other

2) PC = Project coordinator, WPL = Work package leader, WPCL = Work package co-leader, P = Participant

3) inclusive e-mail address

2. Summary

2.1 Final project summary suitable for web publication for a wider audience

The ProYoungStock project aimed to improve the lives of young cattle and conducted research in 8 European countries: Austria (AT), France (FR), Germany (DE), Italy (IT), Poland (PL), Slovenia (SI), Sweden (SE), and Switzerland (CH). Interviews with 104 dairy farmers in AT, FR, DE, IT, SE, CH showed that many diverse cow-calf contact systems (CCC) are practised in Europe. Better animal welfare and reduced labour were perceived as benefits of CCC, while stress when cow and calf are separated, lower amounts of saleable milk, and building constraints were seen as challenges.

Trials in different countries with either focus on feeding strategies (e. g. more milk, use of supplements as linseeds or tannins, silage vs. no silage) or different rearing systems (i.e. 7 different CCC systems compared to control without CCC) revealed the following results concerning:

Calf growth: Calves benefited from increased milk levels (10-12 l/day compared to 6-8 l/day) (DE, AT), from permanent CCC compared to control (PL), from CCC when fed by dams before morning milking and with 6 h/day access to dams until weaning. But there was no impact when CCC of 6 h/day was carried out for only 3 weeks (FR) as well as when CCC was restricted to 2 x 30 min/d until 16 weeks of life. These results show that CCC alone does not necessarily promote calf growth!

Behaviour disorders and welfare: Main behaviour disorders in calves are sucking each other (cross sucking) or manipulating any objects with their mouth. We observed less cross sucking in calves with permanent foster cow contact and with 2x30 min/d contact to the dam (CH, PL). Calves with permanent foster cow contact also manipulated less objects compared to bucket fed calves (PL). Increased milk feeding (DE) and limited access to the dam 2x30 min/d (CH) however, did not reduce those manipulations. CCC calves had lower hair cortisol contents (less stress) before weaning, but after weaning they vocalized earlier and longer (indicating stress) than control calves. (FR).

Calf health: Immunoglobulin-levels in calves' serum from mothers supplemented with linseeds 30 days before and after calving were higher than in calves from control mothers (PL). However, calf health in 5 variations of CCC systems did not differ compared to control systems (PL, FR, SE, and CH). We found no relevant effect of CCC on the gut microbiota development in calves, nor on the passive immune transfer from cows to neonatal calves (FR), nor on a further build-up of the active immune defence during the pre-weaning period (FR, CH).

Cow health: There were no differences in somatic cell count (udder health indicator) and cows' health events in 3 variations of CCC-systems compared to control (FR, SE). CCC practices did not influence contents of immunoglobulin G and lactoferrin in cow's milk (FR, CH). Reproductive performance of multiparous cows did not differ between CCC and control, but was improved in primiparous cows in CCC systems (FR, CH, and SE). Extensively reared animals showed lower disease incidences than animals that did not have this experience (AT, FR), but there was no influence of extensive rearing on calving interval (AT, FR, SI). There was no difference between farms with or without silage feeding regarding reproduction (AT, DE, SI), but a negative effect of silage free rearing on udder health was found (AT, DE).

Milk contents: In CCC-systems we found higher protein contents and lower fat contents (except when calves suckled before milking) than in milk from control cows (FR). Linseed-feeding before calving increased unsaturated fatty acids in colostrum (PL). Milk and fat yields were higher with silage feeding than without in AT, DE, FR, but lower in SI. Feeding tannin extracts to cows during the dry season (hay feeding) revealed lower urea contents, a better fatty acid profile and a higher antioxidant capacity in milk and cheese (IT).

Meat quality: pH of meat 24 h after slaughter was lower in calves with foster cow rearing, but the main fatty acids did not differ between calves from CCC systems and control (PL, CH).

Economic impact of CCC: CCC systems produced 21% to 43% less saleable milk compared to control. The best compromise between milk yield and calf growth was reached with 6 – 9 h CCC between morning and evening milking until weaning (SE, FR).

Ecological impact of tannin feeding: *In vitro* blended tannin extracts reduced ruminal protein degradation and ammonia and methane emissions; especially when hay feeding was simulated (IT).

As there is no one-fits all solution (but there are many pieces of a puzzle), the large variation in management led us to organise many workshops for farmers, so they could exchange on the diverse possibilities of CCC and find out which is the best one for their farm. Those workshops are great to introduce CCC-systems because farmers advise farmers.
More information for farmers and the scientific community is available at www.proyoungstock.net.

2.2 Process update of the whole project

The main objectives of the whole project are fulfilled. But there were some small deviations:
WP1, Task 1.1: SI did not perform any interviews and PL did not find any herds fulfilling the inclusion criteria. Therefore, no data from these two countries could be collected. In Task 1.2 SI did not deliver any data and was therefore excluded. The titles of the deliverables D1.1, D1.2, and D1.3 were slightly changed.
In WP2 the objectives are fulfilled. Analyses were partly considerably delayed due to the Corona pandemic (close-down of laboratories). This impacted data analysis and therewith delayed the submission of papers for peer-reviewed publications. Peer-reviewing processes have also been affected by the pandemic situation, extending the fulfilment to deliver beyond prolongation of the project. In Task 2.1 the number of cow-calf couples included in the trials was lower than initially planned due to difficulties to recruit commercial farms for experiments in SE (36 instead of 100 cow-calf couples). The Swedish farmers enrolled wanted to keep a rather low number of cow-calf pairs (n=3) for each batch, because the method was new for them and they could not handle more. It was not possible to find more farms. The task was initially planned with foster cows and dams. Later it was decided to use only dams to increase comparability, and therefore less farms could be integrated. In Task 2.2, the sampling of milk, teat skin and faeces for microbiota analyses was replaced by a direct sampling of rumen content from female calves before and after weaning. This change enabled to have a direct description of the rumen microbial communities of the calves instead of indirect estimations. Results on immunoglobulin G and lactoferrin content in milk from Swiss trials are included in a manuscript for peer reviewed publication, merged with results obtained in Task 3.2. In Task 2.3, the SI experiment following the same protocol as in PL was delayed and started in December 2019. Samples were sent to PL in April 2021, due to Covid. Data could not be analysed before the end of the project.
In WP3 the objectives are fulfilled. In Task 3.1 it was not possible to recruit enough organic farms: one conventional farm (near-organic calf management and housing) in AT had to be included to fulfil this task. The near organic farm was as relevant as the others for the conclusions and did not influence the results in a certain way. In Task 3.2 the title of Deliverable 3.2 was changed as in CH only farms with mother-bonded calf rearing and none with foster cows could be recruited for the trials. But the trials could all be carried out in the foreseen way. Results on meat quality are presented in a separate report instead of the paper. As restaurants closed down due to the Corona pandemic animals were partly much older than planned when they were slaughtered, leading to high variation of age in the data set. Economic evaluation in 3.2 was carried out in PL and is also covered in Task 1.3.
In WP4, most objectives could be fulfilled. Due to difficulties in recruiting appropriate farms, the data collected in FR (Tasks 4.1 and 4.2) are not from certified organic farms. However, all farms can be characterised as low or moderate input farms. Similarly, in SI not only organic farms could be recruited; further only data from 18 (14 conventional, 4 organic) farms could be used due to class occupancy reasons. The partners agreed to focus on 1st lactating cows. Data from older cows and thus longevity related traits remained optional. Partners from FR and DE analysed longevity related traits additionally within country (Musati, 2019; Thiessen, 2020). Colostrum and milk samples collected in pilot farms with different feeding regimes (FR, SI) should have been analysed with regard to quality parameters such as fatty acid patterns and antioxidant capacity at UCat (IT). Due to the Corona pandemic and the resulting problems regarding farm visits and transportation of samples, this objective could not be fulfilled. However, samples from SI that were sent to PL (WP 2) included colostrum samples for WP 4. The colleagues from PL offered to analyse the data for WP4; however, the start of analyses is as late as December 2021.
WP5: All objectives are fulfilled. In addition, individual cheeses were made and analysed in task 5.2.
WP6: All objectives are fulfilled. Only the website on calf rearing was not started in FR, because other websites for farmers were created with links to calf rearing.

3. Outcomes of the project

3.1 Main results, discussion, conclusions and fulfilment of objectives

WP1	*Rearing of young stock allowing cow-calf contact: on-farm strategies, legislation, and economic aspects*

WP leader: SLU (SE)
Responsible partners: BOKU (AT), FiBL (CH), IGHZ (PL), INRAE (FR), SLU (SE), UCat (IT), HF-SLO (SI), UniKassel (DE)

Overall summary of main results, discussion and conclusions of WP1

There are different strategies for allowing cow-calf contact (CCC) implying possible benefits but also challenges. The aim of WP1 was to gain knowledge and describe existing strategies, to explore farmers' motivators and barriers for practising CCC systems, to compare current legislation regarding calf rearing with cow contact between countries and to evaluate the economic consequences of using different calf rearing strategies.

Task 1.1: A majority of the organic dairy farmers separate cow and calf shortly after birth. There are, however, a number of alternative rearing practices used, which allow CCC. In this task, we identified and described currently practised CCC systems allowing contact between calf and dam or foster cow for more than seven days. This was done in seven of the consortium countries by semi-structured interviews performed face-to-face or via telephone. The collected data gave us detailed information from 104 farms about the currently practised rearing systems allowing CCC, and also farmers' views on CCC systems.

Task 1.2: The aim of Task 1.2 was to examine the interpretation of current EU legislation and national standards, with focus on e.g. animal protection, milk hygiene, organic agriculture, relevant for systems practicing calf rearing with mother contact and milk production. A questionnaire was developed and filled in by all consortium partners except Slovenia. In cases where there were uncertainties, relevant authorities and experts in each country were consulted. The results were compiled and gave us information about the legislation and certification standards affecting calf rearing with cow contact in the respective countries.

Task 1.3: Strategies identified in Task 1.1 formed the basis for scenarios used to assess the economic consequences of CCC systems. Three different CCC systems were compared against each other and with a baseline where cow and calf were separated within the first day. Costs and benefits at farm level, including production parameters from scientific literature and farmer's interviews (Task 1.1) were used to estimate the impact on the gross-margin for the different calf rearing strategies. All modelling was performed in Microsoft Excel with @Risk add-in to enable stochastic handling of certain key variables (milk consumption, forage and concentrate intake and cumulative mortality). The results from WP1 showed that there are dairy farms practising CCC systems in all included countries, except Poland. The strategies and drivers vary more within than between countries. There were only marginal differences when comparing the implementation of the EU organic production regulations and national rules and regulations in the consortium countries. The economic analysis demonstrated that two of the CCC strategies studied resulted in a lower contribution margin i.e. reduced farm profit, which indicates the need of marketing possibilities for achieving a higher milk price for this type of milk to cover the higher production costs.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

A- results obtained and structured in relation to the user groups they are relevant for:

In Task 1.1, interviews with 120 dairy farmers in seven countries were conducted during the fall/winter of 2018. All partners were responsible to conduct the interviews in their own country. The interviews followed a standardised questionnaire consisting of 55 items. The criterion for entering an interview was that the farmer kept cows and calves together for more than seven days. The information from the interviews was compiled in Netigate and in total 104 interviews could be included in the analysis. We found that CCC was practised on a wide variety of farms, from small farms with outdoor housing to large farms with technology intensive systems. The calves were reared together with their dam, with other lactating foster cows, or using a combination of the two. It was also common to manually milk feed the calves during

parts of the milk period. How much time cows and calves were kept together varied between farms, from 30 minutes per day to permanent contact except at milking. Many farmers reported stress-related behaviour when cows and calves were separated, and building constraints were most often mentioned as a barrier for implementing CCC. Efforts to optimize weaning and separation practices, and to improve indoor housing on cow-calf contact farms would be beneficial for this growing sector. Furthermore, the survey indicated that farmers perceived several benefits of keeping cow and calf together (e.g. increased animal welfare and potentially higher profits) but also constraints (e.g. stress when cow and calf were separated and lower amounts of saleable milk). The results from the first task are relevant for farmers, researchers and the society. A draft version of the manuscript for a scientific paper, that will be submitted in December 2021, can be found here: https://orgprints.org/id/eprint/42910/

In Task 1.2, the inventory of the implementation of the EU organic production regulations in national rules and regulations indicated marginal differences between the consortium countries. Our results did not identify any major barriers in national rules for the use of rearing systems allowing CCC. Instead, CCC is promoted by the requirement to feed organic calves preferably maternal milk during the first three months of life. Specifications regarding calf rearing derive from animal protection legislation rather than regulations of organic farming but milk hygiene regulations can also have an influence on practicability of CCC. Variations in national legislations can affect details of design and implementation of CCC systems, but other factors (e.g. overall conditions for organic dairy farming, traditions, economics and disease prevention strategies) rather than regulations play important roles. The results are of importance for policy makers and also for farmers: https://orgprints.org/id/eprint/39785/ we investigated how farms' profitability is affected when they use rearing strategies that allow CCC. Three different strategies were analysed using a stochastic partial budgeting approach. Input parameters for the models were obtained from scientific literature. The following rearing strategies were selected: *Cow-calf contact with restricted suckling* – dam and calf were kept apart for most of the day. They were together for 15 minutes before milking, twice a day. *Initial cow-calf-contact followed by manual milk feeding* – in this system, cow and calf were kept together throughout the day for the first three weeks. Thereafter, they were separated. Calves were group housed for the rest of the milk feeding period and were fed whole milk via a bucket or milk taxi. *Mixed rearing with full contact* – calves spent the first nine days with their dam. They were then separated and moved to foster cows. These three strategies were compared with a baseline scenario where calves were separated from the cow during their first day of life and fed 8 litres of whole milk during the milk feeding period. The analyses showed that milk yields (amount of saleable milk) decreased when calves consumed a higher milk ration, as they did in two of the CCC systems that allowed contact for the majority of the day. For CCC with restricted suckling, calves consumed less than 8 litres of milk per day. Roughage and concentrate consumption, mortality and disease events differed between the studied rearing strategies but milk consumption was the variable with the greatest impact. Possible long-term effects of CCC (e.g. the calf could become more robust and have an increased milk production as an adult cow) were not included and more scientific studies are needed. It is of interest how dairy farmers can obtain an increased payment for products with higher production costs. The output from this task is of importance for farmers, dairies, retailers, policy-makers and consumers. A draft version of the paper that will be finalized and published in a scientific journal during 2022 is found here: https://orgprints.org/id/eprint/43003/

B- fulfilment of objectives:

All milestones and most deliverables are fulfilled. There are some deviations. In the application the title of the report (D1.1) 'National standards and regulations for young stock rearing' was changed to 'Review of the regulations concerning organic dairy calf rearing in seven European countries'. Slovenia did not deliver any information in Task 1.2 and was therefore excluded. In Task 1.1, Slovenia did not perform any interviews and Poland did not find any herds fulfilling the inclusion criteria. The title of the paper (D1.2) was changed to 'Strategies for Keeping Cows and Calves Together on 104 European Dairy Farms – a Cross-Sectional Survey Study' from 'Innovative young stock rearing systems under current legislations'. Also, a minor modification was made to D1.3 where the preliminary title is 'Assessing economic consequences of three cow-calf contact systems in dairy production using a stochastic partial budgeting approach'. The remaining deliverables (D1.1 and D1.3) will be submitted to Animal and Livestock, respectively.

WP2	*Innovative methods for dairy calf rearing focusing on boosting the immune system*

WP leader: INRAE (FR)

Responsible partners: FiBL (CH), IGHZ (PL), INRAE (FR), SLU (SE), HF-SLO (SI)

Overall summary of main results, discussion and conclusions of WP2

We investigated the hypothesis that (1) dairy calf rearing allowing mother suckling improves cow and calf health and welfare, without negative impacts on productivity and (2) enriched colostrum through feed supplements reduces disease susceptibility in calves. Trials in FR and SE investigating the effects of dairy calf rearing allowing mother suckling (CCC) before morning milking or daytime cow contact showed that cows gave, during the first 4 months of lactation from 5 to 13 kg/d (21% to 45%) less milk at parlour than control (CT) cows without calves suckling. Milk protein content was higher in CCC cows compared to CT, but fat content was lower except in cows feeding calves before milking. There were no differences in somatic cell count (SCC) nor in cows' or calves' health events. Calves' growth until weaning was equal or higher according to CCC practices and the best compromise between milk yield and calf growth was reached with daytime CCC until weaning. CCC calves had lower hair cortisol contents (less chronic stress) before weaning, but at weaning they vocalised earlier and longer (indicating stress) than CT calves. CCC practices had no adverse effect on the passive immunity transfer from cows to neonatal calves' and did not modify the build-up of the active immune defence of calves. CCC practices did not influence the cows' milk content in immune (IgG) or antimicrobial (lactoferrin) compounds and had no relevant effect on the gut microbiota development in calves. CCC practices had limited short-term effects on grazing of calves during their first grazing experience. Reproductive performance did not differ between CCC and CT multiparous cows, but was improved in primiparous CCC cows. Linseed supplementation in feed rations of dams before calving (LS) influenced colostrum quality compared to control cows without supplementation (CT) in the direction of higher concentrations of unsaturated fatty acids, which can limit pathogenic bacteria. IgG-levels in calves' serum from LS mothers were higher than in calves from CT mothers.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

Task 2.1: In FR, different trials were implemented at an INRAE experimental farm. In total, five CCC practices (70 cow-calf couples in total) allowing dam contacts (20 min to 9h/d applied to all or only female calves until 3 weeks or until weaning) were compared to a CT practice (42 cow-calf couples in total) where calves were separated from their dam at birth and fed with tank milk. One of the CCC tested (2h30 suckling after morning milking) was prematurely stopped when the calves were 8 weeks old as calf growth became too limited. During the first 16 weeks of lactation, milk yield at parlour was 45% (-10.6 kg/d) to 21% (-5.4 kg/d) lower in CCC cows compared CT cows according to the CCC practices. Milk losses at parlour were due to milk drunk by calves and to a lower total milk production estimated at -275 kg/lactation. Milk protein content was systematically higher in CCC cows (+1.0 to +3.0 g/kg) and milk fat content was lower in CCC cows (-0.8 to -5.8 g/kg) except when suckling occurred before milking (+3.2 g/kg). There were no significant differences in milk SCC and in frequency of health events between CCC and CT animals and calf growth until weaning was higher or similar according to the CCC practices implemented. Calves' hair cortisol content (an indicator of chronic stress) was lower in CCC than in CT calves but at weaning, CCC calves and cows started to vocalize earlier and continued longer than CT, demonstrating that abrupt weaning stresses both cows and calves. Finally, CCC practices had limited short-term effects (few days) on grazing and social behaviour of calves during their first grazing experience. The best compromise between cow milk yield and calf growth is a daytime contact until weaning. In SE, the trial was carried out on two organic dairy farms. In the CCC groups (18 cow-calf couples), cow and calf were kept together daytime until weaning. In the CT group (21 cow-calf couples), calves were separated from dam after 1-3 days and were manually fed 9-10 kg/d of milk from the tank. The CCC cows gave on average 42% less milk per day during the first 90 days of lactation and 9% less milk per day after weaning (days 100-120). The average daily milk production during the first 130 days was reduced by 9 and 13 kg in farms A and B, respectively. There was a tendency for higher SCC in CCC cows. The CCC calves gained on average 35% more weight per week compared to CT calves. Results are reported in a report (https://orgprints.org/id/eprint/43032/) and

in one publication (https://doi.org/10.3389/fvets.2020.600949) and a conference paper (https://orgprints.org/id/eprint/40425/). Another publication was submitted on the 17th of December 2021 (https://orgprints.org/id/eprint/42896/) and a third publication is under preparation.

Task 2.2: In order to verify whether the immune status of calves varied according to the rearing system, specific analyses were made on samples collected in two on-farm trials performed by FiBL (details in Task 3.2) and one of the trials performed by INRAE (see details in Task 2.1). In total, 23 control cow-calf couples (teat bucket fed calves) were compared to 21 cow-calf couples with restricted CCC (0.5 h, twice a day) in CH, and 14 cow-calf couples (milk dispenser fed calves) were compared to 28 cow-calf couples with daytime CCC in FR. In both INRAE and FIBL trials, IgG content of serum and cow milk, as well as milk lactoferrin (a major milk antimicrobial compound) did not vary significantly between rearing systems. CCC did not modify the passive immune transfer from cows to neonatal calves nor the further immune status of calves and milk antimicrobial content did not differ between cows sucking their calf or not. INRAE also monitored the rumen and gut microbiota development according to the feeding strategy of calves. The feeding strategy had no major effect. Finally, we collected and merged reproduction performances of cows from all experiments performed in FR, CH, and SE where cow-calf couples were reared with (n=142) or without (n=117) CCC. We found no significant difference in multiparous cows, but reproductive performance of primiparous cows (which is generally worse than multiparous ones) was improved by calf contact. An equivalent data treatment will be completed on the health data collected in the same experiments. Results are reported in two reports (D2.2.1 https://orgprints.org/id/eprint/43039/, D2.2.2 https://orgprints.org/id/eprint/42950/) and in one publication submitted on the 21st of December 2021. Another publication is under preparation.

Task 2.3: The aim of the study was to determine the influence of linseed supplementation in feed rations (LS) of the dam compared to control (CTL) without linseed supplementation on the quality of colostrum she produced until day 7 post-partum. Colostrum of LS cows showed higher concentrations of unsaturated fatty acids (PUFA) including CLAc9t11, C18:2n-6 and C18:3n-3 in the 1st and 2nd intake. It should be emphasized that C18:2n-6 and C18:3n-3 inactivate methicillin-resistant S. aureus strains and that C18:3n-3 supports the adhesion of Lactobacillus casei on the mucosa surface and stimulates their growth, while limiting the development of pathogenic bacteria. Therefore, it can be concluded that colostrum characterized by a higher concentration of PUFA could improve calf rearing during the first weeks of life due to its higher immune-stimulatory properties. The performed research proved a significant influence of the applied supplementation on an increase of the IgG level in calves. Results are reported in one publication (https://doi.org/10.3390/ani10081293).

The WP2 results are interesting for farmers, advisors, teachers, and the scientific community as they broaden the knowledge regarding CCC systems with regard to animal performances. They demonstrate that CCC positively affects reproductive performance in primiparous cows and that the measured immune parameters stay unaffected as well as animal health and that linseed supplementation can positively modulate colostrum quality.

B- fulfilment of objectives:

The objectives initially defined were all fulfilled and supplementary measurements were even done (i.e. calves grazing behaviour), but some deviations from the original project proposal occurred. Pandemic induced closure of laboratories considerably delayed sample analysis and submission of papers for review.

In **Task 2.1** the number of cow-calf couples included in the trials was lower than planned due to difficulties to recruit commercial farms for experiments in SE (36 instead of 100) and farmers wanted to keep a rather low number of cow-calf pairs (n=3) for each batch.

In **Task 2.2**, the sampling of milk, teat skin and faeces for microbiota analyses was replaced by a direct sampling of rumen content for female calves which enabled to have a direct description of the rumen microbial communities of the calves instead of indirect estimations. CH Results of 2.2 were included in a manuscript for a peer reviewed paper in WP3: D3.2: https://orgprints.org/id/eprint/42924/

In **Task 2.3**, the SI experiment was delayed and samples were sent to PL in April 2021, due to the Corona pandemic. Data could not be analysed before the end of the project.

WP3	*Optimizing dairy calf rearing through enhanced milk feeding and calf fattening on dairy farms with the help of dams – effects on welfare including health*

WP leader: UniKassel (DE)

Responsible partners: BOKU (AT), FiBL (CH), IGHZ (PL), UCat (IT), UniKassel (DE)

Overall summary of main results, discussion and conclusions of WP3

The overall aim of WP 3 was to investigate feeding systems for organic rearing calves in Task 3.1 and veal calves from dairy farms in Task 3.2. Milk amounts fed and the way of milk provision (dam or bucket) were investigated.

In **Task 3.1**, an experimental multi-site study was performed to investigate the effects of increased milk feeding (10-12 l/d, 'MilkPlus' (MP)) compared to common restricted milk feeding (6-8 l/d, 'Control' (CT)). Data from 10 dairy farms in AT and DE were analysed concerning calf welfare including health. Per farm, 6-15 female calves were randomly allocated to the two treatments MP and CT, which were applied over the milk feeding period of 13 weeks. Behaviour, clinical health and weight gains were recorded in weeks 3/4, 7/8, 11/12 and after weaning in week 15/16. MP calves tended to have higher body weights at the end of the milk feeding period and shortly after and had higher daily weight gains during the milk feeding period. CT calves manipulated other calves more frequently in week 3/4, with no differences later. Clinical health and manipulation of objects showed no association to milk amounts, but the latter decreased when feeding duration of solid feed increased. CT calves spent more time with solid feed during the milk feeding period. MP calves vocalized more after weaning. We conclude that twice daily (teat-) bucket feeding of enhanced milk amounts had limited positive welfare effects.

In **Task 3.2**, three on-farm trials were run on two farms in CH and one farm in PL. All farms were organic dairy farms fattening their own calves in 2 groups: a) with teat bucket feeding (BF), b) with cow contact (CC) (mothers with restricted contacts to the calves in CH =rCC, foster cows with permanent contact in PL =pCC). All calves received around 900 kg milk in 5 months and had ad libitum access to roughage feed. CC calves performed less oral manipulations of pen mates and in PL also of objects than BF-calves. Weight gains of CC calves were higher and pH of meat 24 hours after slaughter was lower only in PL. Avoidance distance, clinical health, body condition, medical treatments, and main meat fatty acids did not differ between feeding groups, but levels differed between farms. We conclude that CCC systems should be recommended because they help to avoid behaviour disorders (cross-sucking) and can lead to better weight gains (with pCC) and do not have any negative influence on other parameters.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

Task 3.1: In an experimental multi-site study in AT and DE, we investigated the effects of an increased level of milk feeding (10-12 l/d, ≙ ca. 14-16% milk of the calves' body weight, 'MilkPlus' (MP)) compared to common restricted milk feeding (6-8 l/d, ≙ ca. 10-12% milk of body weight, 'Control' (CT)); (Ivemeyer et al. submitted). Data from 10 dairy farms (nine certified organic, one near-organic), originally applying restricted milk provision by bucket-feeding in AT (Fleckvieh; 4 farms) and DE (Holstein; 6 farms) were analysed concerning calf welfare including health. Per farm, 6-15 female calves (in total 111 calves) were randomly allocated to the two treatments MP and CT, which were applied over the milk feeding period of 13 weeks, with about three weeks of milk reduction after week 10. Data were recorded during the milk feeding period in weeks of life 3/4, 7/8, 11/12 (±2 days) as well as after weaning in week 15/16. This included welfare measures relating to behaviour, observed from video recordings (cross sucking, manipulating objects, vocalization, duration of feeding solid feed (roughage and concentrates); observation time: 320 min per day distributed over 16 h), to health (clinical scoring), and to performance (weight gain). MP calves tended to have higher body weights at the end of the milk feeding period (weeks 11/12: MP 111.0 kg, CT 104.4 kg) and shortly after weaning (weeks 15/16: MP 138.7 kg, CT 131.1 kg; $p_{group*time\ point}$ =0.095) and had higher daily weight gains during the milk feeding period (week 3/4 to 7/8: MP 939 g/d, CT 818 g/d; week 7/8 to 11/12: MP 1082 g/d, CT 956 g/d; p=0.025). CT calves showed more cross sucking in week 3/4 (MP 2.6, CT 4.5 times per 320 min observation time, p<0.001), with no differences later. Clinical health and manipulation of objects showed no association to milk amounts, but the latter decreased when feeding duration of solid feed increased (p<0.001). CT calves spent more time

with solid feed during the milk feeding period (week 7/8: MP 9.8% of observed time, CT 12.0%, week 11/12: MP 14.4%, CT 17.7%; p=0.008). MP calves vocalized more after weaning (MP 1.6, CT 0.5 times per 320 min, p<0.001), though feeding time with solid feed and weight gain (MP 983 g/d, CT 995 g/d) were similar between treatments. CT calves apparently partly compensated the restricted milk amounts by spending more time with solid feed during the milk feeding period. After weaning, MP calves vocalized more, with large variation between individuals. However, MP and CT showed then similar feeding behaviour and weight gain, indicating limited negative effects. Calves on Austrian farms showed less oral redirected behaviour and better health. Health improvements on the German farms should be sought. We conclude that twice daily (teat-)bucket feeding of enhanced milk amounts under commercial organic or near-organic conditions had only limited positive welfare effects. Stakeholders of the sector were addressed in an international livestock conference presentation (https://orgprints.org/id/eprint/42381/) and the scientific community via a scientific article (https://orgprints.org/id/eprint/42915/).

Task 3.2: In three trials in CH and PL we tested the hypothesis that calves allowed cow contact would benefit with regard to weight gain, health related traits, and show less oral manipulations compared to bucket fed (BF) group mates. In CH (FiBL), we conducted two trials with local German Friesian Cattle (farm 1: n=18 rCC vs 17 BF) and Swiss Fleckvieh calves (farm 2: n=12 rCC vs 11 BF) until the age of 122 days between autumn 2018 and summer 2020 (Bieber et al. 2021, submitted 42924). On farm 1 average daily weight gains (g/d) did not differ between feeding groups (rCC: 815±46 vs BF: 807±42 g/d, P=0.90). On farm 2 calves of primiparous cows benefited from dam rearing (rCC: 1,133±73 vs BF: 714±88 g/d, P=0.002), but no difference was found in calves of multiparous cows. Feeding groups did not differ on neither of the farms in terms of clinical findings regarding vitality, body condition, indicators for diarrhoea and respiratory disorders, although levels differed between farms. This was also true for the number of medical treatment cycles (farm1: rCC: 3.06±0.42 vs BF: 2.72±0.39, P=0.56; farm 2: rCC: 1.00±0.32 vs BF: 1.08±0.30, P=0.85). Number of cross-sucking events was consistently higher in bucket fed calves across both farms (farm 1: BF: 1.34±0.15 vs rCC: 0.92±0.12, P=0.02; farm 2: BF: 0.24±0.06 vs rCC: 0.13±0.03, P=0.02), while manipulation of objects and meat quality measures (pH after 24 hours, fatty acids, colour) did not differ between feeding groups (no meat samples from farm 2). We conclude that restricted access to the mother has a reducing effect on cross-sucking and no effect on the other traits investigated while management conditions show high impacts on calf health and behaviour.

The scientific community was addressed in conference presentations (https://orgprints.org/id/eprint/42747, https://orgprints.org/id/eprint/42751/) and via a scientific paper (https://orgprints.org/id/eprint/42924/). Farmers, advisors and teachers benefit from a practice abstract produced in cooperation with UniKassel (https://orgprints.org/id/eprint/42549/).

The results of the PL-trial with three runs including 30 animals on one organic farm showed advantages of rearing calves with permanent contact to foster cows (pCC) compared to rearing them in a separate pen with buckets (BF): The highest daily weight gains were achieved by pCC calves, which averaged from 1.08 to 1.2 kg/ day compared to BF calves with 0.71 to 1.15 kg/ day. pCC calves had by 0.3 kg higher daily weight gains than BF calves. Cross-sucking and manipulation of objects were found more often in BF than in pCC calves. Meat from pCC calves had a lower pH 24 hours after slaughter than meat from BF calves, which indicates better meat quality and lower stress levels of pCC calves. There were no differences in meat colour and in Omega 3 and Omega 6 fatty acids in the meat except for single acids in the saturated fatty and multi-unsaturated fatty acids. An average of 40 kg more body weight was found before slaughter in pCC compared to BF calves. Assuming that the calves drank a similar amount of milk (1000 kg) during the rearing period, this gives 40 kg x € 2 = 80 € of pure profit. An additional profit is labour reduction when watering the calves, which is 180 days x 0.5 h x € 4 = € 360 during the rearing period. To sum up we can earn an additional € 152 (€ 80 + € 72) per pCC calf.

B- fulfilment of objectives:

The objectives are fulfilled. The title of Deliverable 3.2 was changed as only farms with dams (no foster cows) could be recruited for the trials. Results on Swiss meat quality are presented in a separate report (https://orgprints.org/id/eprint/42913/) instead of a paper due to the fact that restaurants closed down due to Covid, and older animals than planned were slaughtered.

WP4	*Impact of roughage feeding and pasture strategies on health traits of heifers and cows*

WP leader: BOKU (AT)

Responsible partners: BOKU (AT), INRAE (FR), UCat (IT), HF-SLO (SI), UniKassel (DE)

Overall summary of main results, discussion and conclusions of WP4

Animals reared in extensive grazing systems (E1) - like upland/mountain and Karst pasture in Austria (AT), France (FR) and Slovenia (SI) - are compared to animals which did not have this experience (E0) (Task 4.1). Besides that, silage (S1) and silage-free (S0) feeding systems are compared in AT, DE, FR and SI farms (Task 4.2). As data origin (organic, conventional, extensive conventional), breeds, number of records and level of information (farm vs. animal information) varied, analyses were performed within country. Many results were not consistent over all countries and some results were even contradictory between countries. Extensive grazing had no effect on production traits, nor on the fat-protein ratio during the first 120 days in milk, nor on the calving interval. Regarding somatic cell count (SCC), AT E1 cows had a higher proportion of records with elevated SCC during their first standard lactation. In SI, however, test-day somatic cell score of the same group was by tendency lower ($P<0.10$). In AT, the number of days between first and last insemination (FLI) was higher in heifers of the E1 group, while no differences were found for FLI between first lactating E0 und E1 cows in AT and FR. FR E1 Montbéliarde cows had a lower number of days to first service than those of the E0 group. Health data could only be analysed for AT and FR; animals reared on mountainous pastures had lower disease frequencies. It can be concluded that extensive grazing of replacement stock does not affect functional traits in the same way in all countries and breeds. In none of the countries involved, information was available on whether individual animals were grazed during the rearing phase or during lactation or not.

The effect of silage or silage-free feeding systems also differed between countries and breeds. Milk and fat yields in AT were higher in S1 than in S0 farms, while they were lower in SI S1 farms. Significantly lower fat contents were observed in S0 farms in AT and FR compared to S1 farms. In AT and DE, S0 cows had significantly higher protein contents than S1 cows. Lower somatic cell counts and shorter calving intervals, could however not be proven for all countries and breeds involved. Higher somatic cell scores were observed in DE S1 farms. In AT no differences were found, while in FR and SI results significantly differed between breeds. The fat-protein ratio was found to be significantly elevated in DE S1 farms. For fertility traits, no difference between S1 and S0 farms was observed in any of the countries. However, FR S0 Montbéliarde cows had an elevated number of days until first service. For other health traits, no differences were observed. The rearing and feeding regime of replacement stock is complex and influenced by numerous factors. Differences between countries with regard to location and management could have compromised the results.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

A- results obtained and structured in relation to the user groups they are relevant for:

Following the definition of traits agreed on by the responsible partners, data from 484 farms were analysed as follows: in AT 392 organic Fleckvieh farms (Tasks 4.1 and 4.2), in FR: 40 conventional extensive farms (20 for Task 4.1 and 20 for Task 4.2, Holstein and Montbéliarde), in DE: 34 organic farms (Task 4.2, Fleckvieh and Brown Swiss), and in SI: 18 farms, organic and conventional (both Tasks 4.1 and 4.2, Fleckvieh, Brown Swiss, Holstein and crosses). In AT and SI, both effects, grazing and silage feeding were analysed within the same data sets. Traits analysed included: (1) standard lactation records for first calving cows (milk, fat and protein yield in kg (MKG, FKG, PKG) and fat and protein contents (F%, P%); (2) test day records (somatic cell score (SCS), elevated cell count (SCC100) defined as 1 when a minimum of two SCC test day records were above 100,000/ml within the 305-day standard lactation and 0 otherwise, SCC100P the proportion of somatic cell count records above 100,000/ml during the standard lactation of a cow in percent, and fat-protein ratio until lactation day 120 (FPR)); (3) fertility traits (days to first service (DFS), calving interval (CI) and the number of days between first and last insemination (FLI)); (4) health traits (metabolic disorders (MET); mastitis (MAS) and fertility disorders (FERT)).

The effects of mountain/upland/Karst grazing were analysed within country by means of linear mixed and logistic regression models. Effects considered in the models depended on country; they included the fixed

effects mountain grazing and/or silage feeding, year and season of calving, age at first calving and the random effect herd. For the analyses of test-day records the covariate days in milk (linear and quadratic) and the random effect of cow were included. Interaction terms were tested and included when P<0.05.

Task 4.1: In this study, traits of heifers and cows that had been reared at least partially in extensive systems, were compared to those of cows that had been reared on their home farms. No significant differences were observed for MKG, FKG, PKG, F% and P%. With regard to somatic cells, results varied across countries and breeds. In AT Fleckvieh cows with preceding mountain grazing had a higher proportion of elevated cell counts. Similar, but non-significant results were observed for SI, while in FR access to mountain pasture had positive effects on SCC100P in Holstein and negative effects in Montbéliarde cows. No significant differences were found for FPR. With regard to fertility, DFS was significantly longer for FR cows with no previous access to upland pasture, while heifers with mountain grazing in AT had significantly longer FLI. All other traits analysed did not differ significantly. When considering all lactations of FR data (Musati, 2019), neither fertility nor longevity was found to be affected by upland pasture. Finally, for health traits, available for AT and FR only, lower mastitis and fertility disease frequencies were observed for first lactating cows having access to mountain/upland grazing as heifers (P<0.05 in AT, respectively).

Task 4.2: Investigations of the effects of silage (S1) versus hay (S0) feeding concerning other traits than milk yield and -composition as well as milk and dairy product quality traits are scarce (e.g. Haselmann et al., 2020; van den Oever et al., 2021). Effects of S1 versus S0 feeding on health, fertility, and health related traits have hardly been covered in previous research (Knaus et al., 2012). In the current study, we therefore aimed to compare production, health and fertility related traits of heifers and first lactating cows, that were kept in farms with S1 or S0 feeding in AT, DE, FR, and SI. Cows in S0 farms had lower F% in AT, FR, and SI and higher P% in AT and DE. Overall, higher SCS and SCS100 were observed in S1 farms in AT and DE. In FR, this was only observed in Holstein (significant interaction with breed) while in SI, where interactions with breed were also significant for all traits, results were contradictory. Regarding fertility, no differences were observed for any of the traits; the same results were observed when including higher lactating cows in FR (Musati, 2019: https://orgprints.org/id/eprint/43057/) and DE (Thiessen, 2020: https://orgprints.org/id/eprint/41863/). Regarding health traits, trends for S0 farms were observed for higher frequencies of mastitis in DE and fertility disorders in AT. In general, disease frequencies were low, particularly for metabolic disorders.

B- fulfilment of objectives:

Most objectives could be fulfilled within WP 4. Due to difficulties in recruiting appropriate farms, the data collected in FR (Tasks 4.1 and 4.2) are not from certified organic, but low or moderate input farms. Similarly, in SI not only organic farms could be recruited; further only data from 18 (14 conventional, 4 organic) farms could be used due to class occupancy reasons. With regard to optional and compulsory traits to be delivered for the across country analyses, the WP partners agreed to focus on 1st lactating cows. Data on longevity related traits remained optional, and were additionally analysed within country by partners from FR and DE (Musati, 2019; Thiessen, 2020).

Colostrum and milk samples collected in pilot farms with different feeding regimes (FR, SI) should have been analysed with regard to quality parameters such as fatty acid patterns and antioxidant capacity at UCat (IT). Due to Covid19 and the resulting problems regarding farm visits and transportation of samples, this objective could not be fulfilled. However, samples from Slovenia that were sent to Poland (WP2) included colostrum samples for WP4. The colleagues from Poland offered to analyse the data for WP4; however, the start of analyses was as late as December 2021.

WP5	*Feeding plants containing bioactive compounds*

WP leader: UCat (IT)

Responsible partners: INRAE (FR), UCat (IT)

Overall summary of main results, discussion and conclusions of WP5

The objective of WP5 was to assess the effects of dietary plant bioactive compounds in extensive pasture-based feeding systems on product quality and protein use efficiency, with a potential for reducing enteric pollutants emissions. Candidate sources of plant bioactive compounds were screened by UCat and tannin extracts (TE) were selected. INRAE performed an *in vitro* rumen fermentation experiment to assess the effects of two TE when the basal diet was fresh herbage (simulating green pasture availability) or hay (simulating no pasture or low-quality pasture availability). Both TE slowed down ruminal biohydrogenation and rumen microbiota activity only when added to hay. Also, the blend of condensed and hydrolysable tannins (CHT) was more effective in protecting proteins from ruminal degradation (reducing ammonia production), a key point in grazing periods. In the following *in vivo* trial performed by UCat, CHT was fed to Modicana cows in a commercial extensive farm with cow-calf contact (CCC). The experiment was carried out in two seasons: spring (green pasture available) and summer (low-quality pasture available). Individual milk was sampled and analysed for quality parameters. Additionally, individual cheeses were produced in each season and analysed for quality parameters. In spring, CHT had almost no effect on milk and cheese quality. Conversely, in summer, milk from cows fed CHT had lower urea and slightly higher antioxidant capacity. Dietary CHT also improved the fatty acid profile of milk and cheese only in summer. The effect of tannins on cow milk and cheese quality is enhanced when green pasture is not available. This could have practical implications for a more conscious use of tannin sources such as tannin extracts, forages, and agro-industrial co-products. Finally, INRAE tested CHT in an in vitro digestion model simulating the abomasal and intestinal compartments, and analysed the digestive residues using a digestomic/peptidomic approach. Tannin infusion in the rumen led to a clear decrease in protein degradation, especially the RuBisCo that is the major soluble protein in plants. In the simulated abomasum, peptidomics analysis showed more degradation products of RuBisCo in the presence of tannins. The effect of RuBisCo protection by tannins persisted in early-stage, but was not detectable in late-stage intestinal digestion. These results indicate that the soluble proteins protected against rumen degradation are progressively degraded in the post rumen digestive compartments.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

UCat identified tannin extracts (TE) as source of plant bioactive compounds, for its reliability in terms of constant composition, constant availability, and purity (Task 5.1, Deliverable 5.1). The TE selected is a blend of condensed tannins from quebracho (*Schinopsis lorentzii*) and hydrolysable tannins from chestnut (*Castanea sativa*). This TE is used in livestock farming and is admitted in organic farming and the results obtained from the studies of WP5 provide information which may contribute to a more conscious use of such a feeding strategy.

In Task 5.1.b, INRAE conducted an *in vitro* rumen fermentation trial, simulating the conditions of the following *in vivo* trial (Task 5.2), to assess the effect of TE on rumen fermentation and biohydrogenation. Also, another type of tannin extract, obtained only from quebracho, was added to the experimental design. Analyses on fermentation and biohydrogenation parameters have been completed by INRAE and UCat, respectively. Both tannins reduced ruminal ammonia and methane emissions. However, TE was more effective in modulating N metabolism when incubated with hay (compared to green herbage). Moreover, tannins affected biohydrogenation only when incubated with hay (compared to green herbage). This experiment suggested that, when animals are fed a hay-based diet, tannins would likely exert a greater effect on biohydrogenation and N metabolism, compared with grazing period in extensive farming systems. This has potential implication for animal health, N emissions, and product quality. The results are published in a peer reviewed journal (https://doi.org/10.1016/j.anifeedsci.2021.114977; D5.2).

In **Task 5.2**, UCat conducted an *in vivo* trial to assess the effects of dietary TE on the composition and quality parameters of milk from pasture-fed cows in both wet and dry seasons. On an extensive Sicilian organic farm two groups of Modicana cows practising CCC were fed with two different diets (control (CT)

and TE supplementation) in spring and summer (Sicilian wet and dry season, respectively) for 23 days. Individual milk was sampled and analysed for proximate composition, pH, urea, somatic cell count, colour, cheese making properties, antioxidant capacity, and fatty acid profile by UCat. Dietary TE had almost no effect on milk parameters in spring, when the cows grazed on green pasture. Instead, dietary TE reduced milk urea nitrogen and slightly improved milk antioxidant capacity and fatty acid profile in summer, when the diet of cows was based on hay and dry stubble. The results of this experiment are published in a peer reviewed international journal (https://doi.org/10.1038/s41598-021-99109-y; D5.3i.b). In addition, at the beginning and at the end of each season, milk from each animal was processed into cheese at CoRFiLaC of Ragusa, Italy (supervisor: PhD Margherita Caccamo), and aged for 25 days. Cheese was analysed for chemical composition, proteolysis, colour parameters, rheological parameters, fatty acid profile, and odour-active volatile compounds by UCat, INRAE, and CoRFiLaC. In spring, dietary TE had almost no effect on cheese parameters. Instead, in summer, the cheese from cows fed TE had a better fatty acid profile, with a lower n-6:n-3 polyunsaturated fatty acid ratio. Regardless of the season, dietary tannin supplementation had no detrimental effect on cheese making, and the slight effects we observed on aromatic compounds would likely not affect cheese sensorial characteristics. The results of this experiment are published in a peer reviewed journal (https://doi.org/10.3168/jds.2021-20292; D5.3i.a). The results of Tasks 5.1 and 5.2 have practical implications for farmers, especially those in extensive and/or organic systems. The supplementation of tannins in the diet of cows, at low to moderate levels, is expected to have greater effects on rumen metabolism, N emissions, and product quality in the periods in which green pasture is not available or, in any case, when the diet is poor in protein and rich in low-digestible fibre. Probably, the dietary supplementation of tannins should be adapted to the basal diet, with higher doses as the protein and/or the low-digestible fibre contents increase. Our results could support a more conscious use of tannin-rich extracts and other tannin sources such as agro-industrial co-products and forages.

In **Task 5.3**, the effects of TE on protein digestion in the rumen of sheep and in simulated abomasum-small intestine conditions were investigated at INRAE using an approach combining a dynamic in vitro digestive system and digestomics. TE infusion in the rumen led to a clear decrease in protein degradation-related fermentation end-products, whereas RuBisCo protein was more abundant than in CT wethers. In the simulated abomasum, peptidomics analysis showed more degradation products of RuBisCo in the presence of tannins. The effect of RuBisCo protection by tannins continued to impact RuBisCo digestion into early-stage intestinal digestion, but was no longer detectable in late-stage intestinal digestion. The peptidomics approach proved a potent tool for identifying and quantifying the type of protein hydrolysed throughout the gastrointestinal tract. The results of this experiment and data have been submitted to peer reviewed international journals. They will help researchers and producers of tannin-rich resources to better understand their mode of action with potential improvements in protein use efficiency by ruminants.

B- fulfilment of objectives:

Task 5.1: Tannin extract from quebracho tree and chestnut tree were selected as plant bioactive compounds source (Intern report in PM 6 (D5.1)). **Task 5.1.b:** *in vitro* rumen fermentation in the presence of TE completed, the results published in *Animal Feed Science and Technology* in PM38 (D5.2). This task was not initially planned and was added because collecting rumen content samples from experimental animals of **Task 5.2** was not possible. This experiment will contribute to better understand the results of the *in vivo* trial. Task 5.2: *in vivo* experiment about the effect of dietary TE on cow's milk, in both wet and dry seasons, is completed, the results published in *Scientific Reports* in PM 42 (D5.3i.b). The study on the effect of TE on cheese quality was not initially planned in Task 5.2, and it was added considering that milk from Modicana cows is almost exclusively processed into traditional cheese. This study is completed and the results published in *Journal of Dairy Science i*n PM 39 (D5.3i.a). **Task 5.3:** Tannin extract tested with the *in vitro* post-rumen digestion model (PM12). This study is completed, and the results and data have been submitted to *Journal of Agricultural and Food Chemistry* and *Data in brief*, respectively.

WP6	*Project coordination and dissemination*

WP leader: FiBL (CH)

Responsible partners: BOKU (AT), FiBL (CH), IGHZ (PL), INRAE (FR), SLU (SE), UCat (IT), HF-SLO (SI), UniKassel (DE)

Overall summary of main results, discussion and conclusions of WP6

The project was coordinated by FiBL who organised regular online meetings and three main project workshops (kick-off, mid-term and final meeting). It installed a password protected co-working area to store and share project documents within the consortium and hosts the project website. FiBL also accompanied the adaptation of the time schedules to the Covid induced project prolongation and coordinated two reporting processes. The consortium realized diverse and numerous dissemination activities, including classical scientific papers, but broadly addressing farmers via a series of workshops, by practice abstracts, technical leaflets, and through websites presenting best practice movies.

Report on the results obtained (A), and fulfilment of objectives (B) comparing to the original project proposal

A- results obtained and structured in relation to the user groups they are relevant for:

Project consortium:

In Task 6.1, FiBL acted as coordinator for the whole project. FiBL coordinated regular online meetings (Skype or Zoom) to ensure information exchange, to solve problems and to identify delays, and recorded the results of 25 meetings during the project period. Together with the local hosts, FiBL organised the kick-off meeting in Catania, Italy (2018 April 24 to 26, host: UCat team), the mid-term meeting in Gdánsk, Poland (2019 October 1-3, host: Tomasz Sakowski) and a final online meeting (2021 May 3-4, which could not take place in presence due to the Covid induced pandemic situation (it was planned in France at INRAE). Coordinators also maintained contact with the CORE Organic Cofund office via mail, e.g. to settle formal problems with the Italian Core organic funding body or to restructure the time schedules after project prolongation necessity due to the impact of Covid on the project.

FiBL had to provide the Slovenian partner with an ultimatum to communicate with partners and to fulfil the promised tasks repeatedly. Finally, the Slovenian partner only partly fulfilled its commitments (see descriptions above).

FiBL installed a password protected co-working area to store and share project documents among project partners.

In Task 6.2, FiBL hosted the project website www.proyoungstock.net containing information on the project. It created a project logo and coordinated the development and adaptation of the dissemination plan after project prolongation due to the impact of Covid on the project.

As visible in part 3.2 and 4 of this report, the ProYoungStock consortium realised the following dissemination activities:

For the scientific community in total 12 papers (8 published, 4 submitted) have been written within the project, and 6 more are planned. Additionally, results have been broadly communicated as reflected by 18 conference contributions.

Farmers and other stakeholders like teachers at agricultural schools, advisors, members of breeding associations and journalists have participated in diverse workshops (33 in total) in different countries (CH, DE, FR, IT, PL, SE, SI). Due to the pandemic situation, a large number of the workshops were held as online events. Especially in Germany, this allowed a very large number of participants, with more than 100 people, mostly farmers, on each evening. At this point, the online format contributed to increase the reach of the dissemination activities. From the dissemination activities in DE, a farmers' exchange messenger group regarding CCC systems emerged.

Two stakeholder-oriented articles on rearing systems with CCC have been published (CH/PL, DE), a further one has been submitted and will be published in January 2022 (DE), another article on effects of extensive rearing of young stock on subsequent performance and functional traits is planned (AT). Two practice abstracts, one on effects of linseed supplementation and one on strategies for separation and weaning in CCC systems were produced. An additional third one on test day recording when practicing CCC systems will follow in summer 2022.

Students were given the opportunity to graduate at different levels within this project (1 Post doc fellowship, 2 PhD -, 14 Master-, and 7 Bachelor- thesis, plus 3 working papers were realized).

Two websites on CCC systems linking to movies for best practice examples were installed or maintained with help of the project funding (PL, CH), two websites with project information were installed (SE,SI).

A full overview of Deliverables with links is reported in 3.2.

B- fulfilment of objectives:

Most objectives have been fulfilled, with exceptions and delays described above. Many of the workshops planned as live events had to be postponed due to Covid and were finally carried out as online events. Some of the papers could not be produced in time, partly due to close down of laboratories and also due to overlap of work after project prolongation.

3.2 Deliverables and milestones status

Deliverable No.	Deliverable name	Link to the document[2)]	Planned delivery month[1)]	Actual delivery month[1)]	Reasons for changes/delay and explanation of consequences in case of delay, if any
D5.1.	Selection of the sources of plant bioactive compounds (Report)	Report: https://orgprints.org/id/eprint/36483/	7	7	
D1.1	National standards and regulations for young stock rearing (Report)	https://orgprints.org/id/eprint/39785/	14	37	It took longer time than expected to gather data from all consortium countries and compile the report. The report was uploaded on FiBL workspace in Feb. 2020 and is available on Organic e-prints since April 2021.
D1.2	Innovative young stock rearing systems under current legislations (Paper)	https://orgprints.org/id/eprint/42910/	18	45	A delay was expected, due to longer time for data retrieval. Submission planned for PM 41
D6.6.4	National workshops for farmers and advisors on plant secondary compounds (Workshop, UCat, INRAE)	https://orgprints.org/id/eprint/42888/	20	39	Workshop planned for 2020 had to be postponed to June 2021 (PM 39) due to Covid.

D5.2	Effects of plant bioactive compounds on protein digestion, animal performance, and animal health (Paper, UCat)	Paper: https://doi.org/10.1016/j.anifeedsci.2021.114977 Organic eprints link: https://orgprints.org/id/eprint/40130/	24	26 (submitted) 38 (accepted)	
D1.3	Economic consequences of different natural calf rearing strategies (Paper, SLU)	https://orgprints.org/id/eprint/43003/	28	50	Delayed due to difficulties of performing farm visits to retrieve data from enrolled farmers. Expected delivery i.e. submission of manuscript in PM 50
D3.1	Effects of enhanced milk feeding on health and welfare of rearing calves (Paper, UniKassel)	Conference contribution: https://orgprints.org/id/eprint/39176/ Paper: https://orgprints.org/id/eprint/42915/	35	41 45	Due to delay in data assessemt (see M 3.3) the paper was delayed.
D4.1	Effects of extensive rearing of young stock on subsequent performance and functional traits (Paper, BOKU)	Conference contribution: https://orgprints.org/id/eprint/42827/ Paper: https://orgprints.org/id/eprint/42962 Master Thesis France: https://orgprints.org/id/eprint/43057/	30	35 46	Due to delayed data provision, calculation started delayed. Calculations were finalized in PM 41, manuscript writing is currently in progress.
D6.5	Exchange- and information internet platforms on dam rearing,	Website: FiBL: https://www.bioaktuell.ch/tierhal	30		FiBL: PM28 INRAE: no own website produced SLU: PM 41-42, no own website,but project

	including small movies (Website, FiBL, INRAE, SLU, HF-SLO)	tung/rindvieh/magka-start.html SLU: https://www.slu.se/fakulteter/vh/forskning/forskningsprojekt/not/kv---proyoungstock/ HF-SLO: https://holstein.si/projekti/ IGHZ: https://www.igbzpan.pl/aktualnosc/proyoungstock			description and link to ProYoungStock website HF-SLO: PM 32, no own website, but info related to ProYoungStock project as part of Holstein Slovenia website IGHZ: produced website for dissemination of ProYoungStock results (additional deliverable)
D2.2.2	Antibodies in nursing cows' milk (Report, FiBL, INRAE)	CH/FR: https://orgprints.org/id/eprint/42950/	34	42	Due to close down of laboratories during the pandemic, deliverable was delayed, but not as severely as first expected Results on Swiss trials were integrated in a scientific paper under D3.2 as well. The title was changed as also antibody status in calves was investigated in France.
D2.3.1	Effect of colostrum quality on the gastrointestinal micro flora of calves (Paper, IGHZ, HF-SLO)	Paper: https://doi.org/10.3390/ani10081293 Organic Eprints link: https://orgprints.org/id/eprint/42828/	34	27	Ahead of time
D3.2	Effects of mother-bonded calf rearing on health, welfare and	Conference presentation (EAAP): https://orgprints.org/id/eprint/42747/ (IAHA):	42	41	Change of deliverable title, as only farms practicing mother-bonded were involved. Results on meat quality were not integrated in one paper, as it would

	meat quality in calves. (Paper, Report, Practice abstract, FiBL)	https://orgprints.org/id/eprint/42751/ Practice abstract: https://orgprints.org/id/eprint/42549/ Report: https://orgprints.org/id/eprint/42894/ Paper: https://orgprints.org/id/eprint/42924/		42 42 45 45	have become too lengthy but are delivered as a separate report.
D4.2	Feeding regimes and their influence on milk quality (Paper, BOKU, UCat)	https://orgprints.org/id/eprint/42965/	42	48	The originally planned analyses were not possible. An alternative plan for an analysis with SLO and PL was elaborated. Depending on the results of the analyses (starting in December 2021), a scientific will be written
D5.3	Final publishable reports i) Effects of plant bioactive compounds on animal productivity and health ii) Effects of plant bioactive compounds on protein digestion and immune response in dairy cows	Paper: D5.3 i.a: https://doi.org/10.3168/jds.2021-20292 https://orgprints.org/id/eprint/40083/ stakeholder oriented article: https://orgprints.org/id/eprint/41868/ D5.3 i.b: Paper: https://doi.org/10.1038/s41598-021-99109-y	39	39 (D5.3i.a and D5.3i.b) 42 (D5.3ii)	

	(Report, Paper, UCat, INRAE)	https://orgprints.org/id/eprint/42570/ Stakeholder oriented article https://orgprints.org/id/eprint/42905/ D 5.3 ii: https://orgprints.org/id/eprint/42893			
D4.3	Effects of extensive rearing of young stock on subsequent performance and functional traits (Stakeholder oriented article, BOKU)	https://orgprints.org/id/eprint/42963	35	47	Immediately after scientific article is written
D4.4	Recommendation with regard to milk quality based on feeding regime (stakeholder oriented article, BOKU)	https://orgprints.org/id/eprint/42966	35	48	Depending on results of alternative scenario
D2.1	Keeping cow and calf together – impacts on behaviour, welfare, and farm economy (Paper, INRAE, SLU)	Papers: https://www.frontiersin.org/articles/10.3389/fvets.2020.600949/full https://orgprints.org/id/eprint/42896/ Conference paper: https://orgprints.org/id/eprint/40425/ report:	40	42	Postponed due to Covid-19. Data material from the farms was collected in Sept 2020. First paper published in December 2020 (PM 21) Second paper submitted on the 17th of December 2021.

		https://orgprints.org/id/eprint/43032/			
D2.2.1	Keeping cow and calf together – impacts on gut microbiota development (Paper, INRAE)	report: https://orgprints.org/id/eprint/43039/	36	42	Data material was delayed due to pandemia. The writing of the paper is delayed partly due to lockdown of laboratories. Preliminary results are presented in the report.
D2.3.2	Practice abstract "Linseed supplementation for improvement of colostrum quality" and stakeholder-articles in farmer's magazines (PL and Ireland) (IGHZ)	Practice Abstract: https://orgprints.org/id/eprint/42816/ Articles: ("Hodowca Bydła" 3000 pcs or http://www.portalhodowcy.pl/czasopisma/hodowca-bydla/hodowca-bydla-aktualnosci https://www.igbzpan.pl/uploaded/FSiBundleContentBlockBundleModelTranslatableBlockTranslatableFilesElement/filePath/2029/coreorganicpracticeabstractlinseed-supplementation-pl-.pdf https://www.irishorganicassociation.ie/about/organic-matters-magazine/	24	33	Postponed due Covid-19 and lockdown of the Unviversity of Life Science Additional to the practice abstract stakeholder articles were published
D4.5	Differences in farms feeding silage or non-silage rations (Paper, BOKU)	https://orgprints.org/id/eprint/43057/	28	45	Due to delayed data provision, calculation started delayed. Calculations were finalized in PM 41,

					followed by manuscript writing
D4.6	Article on effects of non-silage feeding (Stakeholder oriented article, BOKU)	https://orgprints.org/id/eprint/42964/	30	46	After scientific manuscript
D6.3	National workshops for farmers and advisors on different calf rearing systems (Workshop, FiBL, UniKassel, VÖP, IGHZ, HF-SLO	DE:https://orgprints.org/id/eprint/39173/ https://orgprints.org/id/eprint/39175/ https://orgprints.org/id/eprint/39420/ https://orgprints.org/id/eprint/39422/ https://orgprints.org/id/eprint/39424/ https://orgprints.org/id/eprint/41858/ https://orgprints.org/id/eprint/41859/ https://orgprints.org/id/eprint/41862/ https://orgprints.org/id/eprint/41871/ https://orgprints.org/id/eprint/42381/ https://orgprints.org/id/eprint/42382/ https://orgprints.org/id/eprint/42742/	30	42	DE (15 events): started ahead of time (PM30), partly online due to Covid PL (1 event): postponed due to Covid-19 and lockdown of the Polish Extension Services , planned for January 2022 at Piątnica Dairy Plant SI: HO-SLO realized 2 online workshops in March 2021 CH: PM 36 (4 events, delayed due to Covid and finally organized as online events: 3 Workshops, 1 discussion with breeder associations SLU (additional delivery): 3 workshops PM31-32 UCat (additional delivery): workshop planned for PM 20, realized in PM 39 (due to Covid) FR (additional delivery): 2 events in collaboration with FR partner involved in GrazyDaisy

		https://orgprints.org/id/eprint/42741/ https://orgprints.org/id/eprint/39174/ SI: https://holstein.si/wp-content/uploads/2021/02/V-A-B-I-L-O_2021.pdf CH: https://orgprints.org/id/eprint/42746/ https://orgprints.org/id/eprint/42877/ https://www.fibl.org/de/infothek/termine/open-fibl-day https://orgprints.org/id/eprint/42879/ SLU: https://orgprints.org/id/eprint/38700/ https://orgprints.org/id/eprint/42753/ https://orgprints.org/id/eprint/38695/ UCat:https://orgprints.org/id/eprint/42888/ INRAE: https://orgprints.org/id/eprint/42745/			

1) Measured in months from the project start date (month 1), status after project prolongation due to Covid
2) E.g. documents as orgprints.org/33121 or other types of deliverable (e.g. APPs or devices)

Milestone No.	Milestone name	Planned delivery month[3)]	Actual delivery month[3)]	Reasons for changes/delay and explanation of consequences, if any.
M 6.2.	Kick off meeting (FiBL +all partners)	3	1	Fulfilled ahead of time, no consequences
M 6.3	Project homepage (FiBL)	4	3	Fulfilled ahead of time, no consequences
M 1.1	Questionnaire national standards and guidelines for interviews (SLU)	5	5	
M 2.3	Data protocol 2.2a (FiBL)	6	10	Protocol development was more time consuming, but delays in this milestone had no impact on the further project work
M 3.1	Data protocol 3.1 (UniKassel, BOKU)	6	9	See above (M 2.3)
M 3.4	Data protocol 3.2 (UniKassel)	6	9	See above (M 2.3)
M 5.1	Sources of plant bioactive compounds selected (UCat, INRAE)	6	6	
M 2.7	Data protocol 2.3 (IGHZ, HF-SLO)	7	7	
M 3.2	Data assessment training (UniKassel)	7	4	Fulfilled ahead of time, no consequences
M 4.1	Data protocol 4.1 and 4.2	7	10	Protocol development was more time consuming, but delay in this milestone had no impact on the further project work
M 2.5	Data protocol 2.2 b (INRAE)	10	12	See above (M2.3)
M 1.2	Evaluation of national standards (SLU)	11	23	It took longer time than expected to gather this data and compile the report. The report was uploaded on project workspace in Feb 2020 and on Organic e-prints in April 2021.
M 1.3	Survey on rearing systems (SLU)	12	22	Delayed due to difficulties to agree on the areas to include in the questionnaire and performing interviews in all countries.
M 2.1	Data protocol 2.1 (INRAE, SLU)	12	12	
M 4.2	Farm selection WP 4 (BOKU, INRAE, UniKassel, HF-SLO)	12	10 (INRAE) 18 (UniKassel) 21 (BOKU) 20 (HF-SLO)	The delay in farm selection at UniKassel delayed data collection (M4.3).

M 1.4	Scenarios for economic modelling (SLU)	14	20	Finished in PM 20 without impact on other WPs.
M 6.4	2nd project meeting (FiBL + all partners)	18	19	
M 2.8	Trials 2.3 finished (IGHZ, HF-SLO) (M 2.8)	20	41	Delayed but trial was finished in January 2020. Colostrum samples from Slovenian trials are planned to be delivered to IGHZ in PM 32, borders were closed due to Covid.
M 3.3	Trials 3.1 finished (UniKassel, BOKU)	20	25	Due to difficulties in finding suitable project farms and less female rearing calves born than expected the data assessment period had to be extended by 5 months.
M 5.2	*In vivo* and *in vitro* trials finished (UCat, INRAE)	20	17	Fulfilled ahead of time, no consequences
M 4.3	Data collection WP4 (BOKU, INRAE, UniKassel, HF-SLO)	24	31	For several reasons, including Covid-19, data collection/data provision was delayed at UniKassel and SLO.
M 3.5	Trials 3.2 finished (FiBL, IGHZ)	25	28	Due to longer calving intervals on one of the farms conducting Swiss trials, we extended the on-farm trials in order to involve the planned number of animals Due to the Covid pandemic and the resulting closure of restaurants, the farmer lost his most important marketing channel. The last calves of this farm are expected to be slaughtered by the end of September 2020. In Poland the last group of reared calves was slaughtered in June 2020.
M 2.9	Laboratory results obtained (IGHZ)	26	36	Delayed due to lockdown of the laboratories related to Covid

				pandemic from April to September 2020
M 2.2	Trials 2.1 finished (INRAE, SLU)	27	FR :27 SE: 30	SE: On-farm trials were finished (in PM 25), but data retrieval is delayed to September 2020 due to the pandemic and workload for participating farmers.
M 2.6	Trials 2.2b finished (INRAE)	27	27	
M 3.6	Meat quality (FiBL, IGHZ, UCat)	28	39	Delayed due to Covid IGHZ: PM 32 sample delivery FiBL: PM31 sample delivery UCat: PM 39 (June): sample analysis finished
M 5.3	Conclusion of chemical and data analyses (UCat, INRAE)	34	34	
M 2.4	Trials 2.2a finished (FiBL)	29	28	Fulfilled ahead of time
M 6.5	Final project meeting (FiBL and all partners)	36	38	Postponed due to Covid pandemic. Finally, we had a virtual meeting in May 2021 (PM 38).
M 6.6	Publications in Organic e-prints (FiBL and all partners)	42		Process to be continued (i.e. for submitted papers, accepted and published version will have to be updated)

3) Measured in months from the project start date (month 1)

4. Publications and dissemination activities

4.1 List extracted from Organic Eprints

Number of items at this level: **101**.

Journal paper

Alvåsen, Karin; Eriksson, Hanna; Ahmed, Haseeb and Fall, Nils (2021) **Assessing economic consequences of cow-calf contact systems in dairy production using a stochastic partial budgeting approach.** *Needs to be decided. Probably 'Livestock Science'*, XX, XX-XX. [draft]

Bieber, Anna; Walkenhorst, Michael; Eppenstein, Rennie; Probst, Johanna; Leiber, Florian; Thüer, Susann; Baki, Cem and Spengler Neff, Anet (2021) **Effects of twice a day teat bucket feeding compared to twice a day mother suckling on behaviour, health traits and blood immune parameters in dairy calves and immune parameters in cow's milk.** *Applied Animal Behaviour Science*, xx, x-xx. [Submitted]

Eriksson, Hanna; Fall, Nils; Ivemeyer, Silvia; Knierim, Ute; Simantke, Christel; Fuerst-Waltl, Birgit; Winckler, Christoph; Weissensteiner, Roswitha; Pomiès, Dominique; Martin, Bruno; Priolo, Alessandro; Caccamo,

Margherita; Sakowski, Tomasz; Spengler Neff, Anet; Bieber, Anna; Schneider, Claudia and Alvåsen, Karin (2021) **Strategies for Keeping Cows and Calves Together on 104 European Dairy Farms – a Cross-Sectional Survey Study.** *Animals*, XX, pp. 1-40. [Submitted]

Fuerst-Waltl, Birgit; Ivemeyer, Silvia; Martin, Bruno; Klopčič, Marija; Fuerst, Christian and Musati, Martino (2021) **Extensive pasture management and its effect on various traits in dairy cattle.** *not decided*, [draft]

Fuerst-Waltl, Birgit; Ivemeyer, Silvia; Martin, Bruno; Klopčič, Marija; Fuerst, Christian and Musati, Martino (2021) **Feeding dairy replacement heifers and cows with or without silage - effect on various health and production traits.** *not decided - maybe Journal of Dairy Science*, [draft]

Ivemeyer, Silvia; Preußer, Johanna; Haager, Daniela; Simantke, Christel; Mayer, Prisca; Kull, Kristina; Utz, Gesa; Knierim, Ute and Winckler, Christoph (2021) **Impact of enhanced compared to restricted milk feeding on the health and well-being of organic dairy calves.** *Applied Animal Behaviour Science*, [Submitted]

Menci, Ruggero; Coppa, Mauro; Torrent, Angelique; Natalello, Antonio; Valenti, Bernardo; Luciano, Giuseppe; Priolo, Alessandro and Niderkorn, Vincent (2021) **Effects of two tannin extracts at different doses in interaction with a green or dry forage substrate on in vitro rumen fermentation and biohydrogenation.** *Animal Feed Science and Technology*, 278, p. 114977.

Menci, Ruggero; Natalello, Antonio; Luciano, Giuseppe; Priolo, Alessandro; Valenti, Bernardo; Difalco, Antonio; Rapisarda, Teresa; Caccamo, Margherita; Constant, Isabelle; Niderkorn, Vincent and Coppa, Mauro (2021) **Cheese quality from cows given a tannin extract in 2 different grazing seasons.** *Journal of Dairy Science*, online, xx-xx.

Menci, Ruggero; Natalello, Antonio; Luciano, Giuseppe; Priolo, Alessandro; Valenti, Bernardo; Farina, Giovanni; Caccamo, Margherita; Niderkorn, Vincent and Coppa, Mauro (2021) **Effect of dietary tannin supplementation on cow milk quality in two different grazing seasons.** *Scientific Reports*, 11, p. 19654.

Nicolao, Alessandra; Coppa, Mauro; Bouchon, Matthieu; Sturaro, Enrico; Pomiès, Dominique; Martin, Bruno and Koczura, Madeline (2020) **Early-Life Dam-Calf Contact and Grazing Experience Influence Post-Weaning Behavior and Herbage Selection of Dairy Calves in the Short Term.** *Frontiers in Veterinary Science*, 7 (1052), pp. 1-11.

Nicolao, Alessandra; Veissier, Isabelle; Bouchon, Matthieu; Sturaro, Enrico; Martin, Bruno and Pomiès, Dominique (2021) **Animal performance and stress at weaning when dairy cows suckle their calves for short versus long daily durations.** *Animal*, -, xx-xx. [Submitted]

Puppel, Kamila; Gołębiewski, Marcin; Grodkowski, Grzegorz; Solarczyk, Paweł; Kostusiak, Piotr; Klopčič, Maria and Sakowski, Tomasz (2020) **Use of somatic cell count as an indicator of colostrum quality.** *PLOS ONE*, 15 (8), e0237615.

Puppel, Kamila; Gołebiewski, Marcin; Konopka, Katarzyna; Kunowska-Slósarz, Małgorzata; Slósarz, Jan; Grodkowski, Grzegorz; Przysucha, Tomasz; Balcerak, Marek; Madras-Majewska, Beata and Sakowski, Tomasz (2020) **Relationship between the Quality of Colostrum and the Formation of Microflora in the Digestive Tract of Calves.** *Animals*, 10 (8), pp. 1-14.

Puppel, Kamila; Gołębiewski, Marcin; Konopka, Katarzyna; Kunowska-Slósarz, Małgorzata; Slósarz, Jan; Grodkowski, Grzegorz; Przysucha, Tomasz; Balcerak, Marek; Madras-Majewska, Beata and Sakowski,

Tomasz (2020) **Relationship between the Quality of Colostrum and the Formation of Microflora in the Digestive Tract of Calves.** *Animals*, 10 (8), p. 1293.

Sakowski, Tomasz (2022) **Feeding regimes and their influence on milk quality.** *not decided yet - depending on results*, [draft]

Newspaper or magazine article

Fuerst-Waltl, Birgit (2022) **Alpung und extensives Weidemangement von Jungrindern. ?** Bio Austria, 2022, [draft]

Fuerst-Waltl, Birgit (2022) **Fütterung mit Silage oder Heu – gibt es Unterschiede hinsichtlich Leistung, Fruchtbarkeit oder Gesundheit bei Rindern?** *? Bio Austria*, 2022, ?. [draft]

Fuerst-Waltl, Birgit (2022) **Fütterung und Milchqualität – was zu beachten ist.** *? Bio Austria*, 2022, ?. [draft]

Schmidberger, Ruth and Ivemeyer, Silvia (2021) **Trennen und Absetzen in der kuhgebundenen Kälberaufzucht.** *Biotopp*, 2021 (5/2021), pp. 33-35.

Spengler Neff, Anet and Sakowski, Tomasz (2020) **Jak po go dzić produkcję mleka z odchowem cieląt przy matkach?** *HODOWCA BYDŁA*, 2020, 6-7, pp. 45-50.

Conference paper, poster, etc.

Alvåsen, Karin (2021) **Costs and benefits of good animal welfare - gains for animals, farmers and society.** Speech at: Webinar: Costs and benefits of good animal welfare - gains for animals, farmers and society, Virtual meeting, 2021-10-26. [Completed]

Alvåsen, Karin (2021) **Economic consequences of cow-calf contact systems.** Speech at: Workshop ProYoungStock and Grazy Daisy, Virtual meeting, 2021-09-30. [Completed]

Alvåsen, Karin (2021) **Keeping dairy cows and calves together – strategies and economic consequences.** Speech at: NordCaw online Conference “Improvements of dairy cattle welfare - development of further sustainable agriculture practices” of Nordic Network for Communicating Animal Welfare (NorDCAW), Virtual meeting, 2021-09-30.

Bieber, Anna (2021) **Physiologische Einflüsse auf Kuh und Kalb.** Paper at: Kuhgebundene Kälberaufzucht, online, 18. Mai 2021. [Completed]

Bieber, Anna; Walkenhorst, Michael; Eppenstein, Rennie; Probst, J.K.; Thüer, Susann; Baki, Cem and Spengler Neff, Anet (2021) **Effect of calf rearing with mother contact compared to bucket feeding on health and welfare of calves.** In: Schmid, Otto; Johnson, Marion; Vaarst, Mette and Früh, Barbara (Eds.) *Proceedings of the IAHA Pre-Conference on Organic Animal Husbandry, 6. and 7. September 2021 linked to the 20th Organic World Congress of IFOAM 2021*, pp. 32-34.

Bieber, Anna; Walkenhorst, Michael; Eppenstein, Rennie; Probst, J.K.; Thüer, Susann; Baki, Cem and Spengler Neff, Anet (2021) **Health and behaviour of dairy calves reared with milk from bucket versus mother during four months.** In: *Book of Abstracts of the 72nd Annual Meeting of the European*

Federation of Animal Sciences. Davos, Switzerland. 30 August - 3 September 2021, Wageningen Academic Publishers, The Netherlands, 27, p. 535.

Disenhaus, C.; Michaud, A.; Genot, N.; Valenzisi, L.; Pomiès, D.; Martin, B.; Chassaing, C. and Le Cozler, Y. (2018) **Coping with citizen demands: a field study of suckling processes in dairy herds.** Lecture at: Book of Abstracts of the 69th Annual Meeting of the European Association for Animal Production, Dubrovnik, Croatia, 27-31.08.2018.

Eriksson, Hanna (2021) **Strategies for keeping dairy cows and calves together on European farms.** Workshop at: Workshop ProYoungStock and Grazy Daisy, Virtual meeting, 2021-09-30. [Submitted]

Eriksson, Hanna (2020) **Aktuell forskning om KoKalv-hållning inom mjölkproduktionen i Sverige.** [Current research about cow and calf keeping in Swedish dairy production.] Speech at: Ekologiska lantbrukarna (Organic farmers in Sweden meeting), Virtual meeting, 10.11.2021. [Completed]

Eriksson, Hanna; Fall, Nils; Priolo, Alessandro; Caccamo, Margherita; Michaud, A.; Pomiès, D.; Fuerst-Waltl, Birgit; Weissensteiner, R.; Winckler, Christoph; Spengler Neff, Anet; Bieber, A.; Schneider, Claudia; Sakowski, Tomasz; Stachelek, Magdalena; Ivemeyer, Silvia; Simantke, Christel; Knierim, Ute and Alvåsen, Karin (2021) **Strategies for keeping dairy cows and calves together on European farms.** In: *Book of Abstracts of the 72nd Annual Meeting of the European Federation of Animal Sciences. Davos, Switzerland. 30 August - 3 September 2021*, Wageningen Academic Publishers, The Netherlands, no. 27, p. 480.

Eriksson, Hanna (2020) **Mjölkproduktion med ko och kalv tillsammans - så funkar det!** [Milkproduction with cow and calf together - this is how it works!] Speech at: Alnarps mjölkdag, Alnarp and virtual meeting, 2020-11-10. [Completed]

Eriksson, Hanna (2020) **Aktuell forskning om KoKalv-hållning inom mjölkproduktionen i Sverige.** [On-going research about Cow-Calf-contact systems in Swedish milk production.] Speech at: Forskning och utveckling inom ekologisk produktion, 2020-10-15. [Completed]

Fuerst-Waltl, Birgit; Musati, Martino; Coppa, Mauro; Fuerst, Christian; Ivemeyer, Silvia; Klopčič, Marija; Martin, Bruno and Winckler, Christoph (2021) **Grazing strategies and their relationship to traits of milk performance testing in cattle.** Paper at: 1st Joint Meeting of EAAP Mountain Livestock Farming & FAO-CHIEAM Mountain Pastures "Mountains are agroecosystems for peope", Bled, Slovenia (online), 7-9 June 2021. [Completed]

Ivemeyer, Silvia (2021) **Systeme der kuhgebundenen Aufzucht – Haltung / Stallbau und das Absetzen der Kälber.** Workshop at: Praxis-Dialog kuhgebundene Kälberaufzucht, Hofgut Oberfeld, Darmstadt, 06.09.2021. [Completed]

Ivemeyer, Silvia (2021) **Systeme kuhgebundene Kälberaufzucht in der Milchviehhaltung - Herausforderungen und Lösungen in der Praxis: Haltung, Trennen & Absetzen, Ammen.** Paper at: Bioland-Seminar Kuhgebundene Kälberaufzucht, online, 27.10.2021. [Unpublished]

Ivemeyer, Silvia (2020) **Systeme der kuhgebundenen Aufzucht – Schwerpunkte auf Lösungen für Haltung / Stallbau und das Absetzen der Kälber.** Workshop at: Praxis-Dialog Kuhgebundene Kälberaufzucht, Fichtenberg und Oberrot/Scheuerhalden, 22. Oktober 2020.

Ivemeyer, Silvia (2020) **Workshop zur kuhgebundenen Aufzucht von Kälbern in der Milchviehhaltung.** Workshop at: Fachberatertagung „ökologische Milchviehhaltung“, Schloss Buchenau, Deutschland, 15.-16.September 2020. [Completed]

Ivemeyer, Silvia (2019) **Podiumsdiskussion Mutter- und ammengebundene Kälberaufzucht.** Podiumsdiskussion 13:00-14:15 at: Ökofeldtage, Fachforum Tier (LLH-Zelt), Frankenhausen, Grebenstein, 03.07.2019. [Completed]

Ivemeyer, Silvia (2019) **Cow-calf session: Presentation of the project ‘ProYoungStock’.** Paper at: Second GrazyDaiSy Workshop, Überlingen, Germany, 11.-13. June 2019. [Completed]

Ivemeyer, Silvia; Haager, Daniela; Simantke, Christel; Mayer, Prisca; Kull, Kristina; Preußer, Johanna; Utz, Gesa; Knierim, Ute and Winckler, Christoph (2021) **Impact of enhanced compared to restricted milk feeding on performance and welfare of rearing calves.** In: *Book of Abstracts of the 72nd Annual Meeting of the European Federation of Animal Science*, OASES, no. 27, p. 401.

Ivemeyer, Silvia and Hub, Anna-Maria (2020) **Muttergebundene Kälberaufzucht (ProYoungStock-Projekt).** Paper at: Züchtertreffen Angler Rind alter Zuchtrichtung, Fuhlenhagen, Deutschland, 19. / 20. Februar 2020.

Ivemeyer, Silvia; Simantke, Christel and Droscha, Anne (2021) **Online-Seminar zur kuhgebundenen Kälberaufzucht - Ammengebundener Kälberaufzucht (4/4).** Workshop at: Online-Seminare zu kuhgebundener Kälberaufzucht, Zoom, 7.7.2021. [Completed]

Ivemeyer, Silvia; Simantke, Christel and Droscha, Anne (2021) **Online-Seminar zur kuhgebundenen Kälberaufzucht - Trennen und Absetzen in der kuhgebundenen Aufzucht (3/4).** Workshop at: Online-Seminare zu kuhgebundener Kälberaufzucht, Zoom, 7.4.2021. [Completed]

Ivemeyer, Silvia; Simantke, Christel and Droscha, Anne (2021) **Online-Seminar zur kuhgebundenen Kälberaufzucht - Kombinierbarkeit kuhgebundene Aufzucht und AMS (2/4).** Workshop at: Online-Seminare zu kuhgebundener Kälberaufzucht, Zoom, 24.3.2021. [Completed]

Ivemeyer, Silvia; Simantke, Christel and Droscha, Anne (2021) **Online-Seminar zur kuhgebundenen Kälberaufzucht - Systeme kuhgebundener Aufzucht und stallbauliche Lösungen (1/4).** Workshop at: Online-Seminare zu kuhgebundener Kälberaufzucht, Zoom, 24.2.2021. [Completed]

Knierim, Ute (2020) **Results from the ProYoungStock survey on CCC rearing systems in practice, and attempts to automatically monitor suckling behaviour and cow-calf interactions under extensive conditions.** Paper at: Cow-calf contact - current and future research, Second Round Table Conference, Thünen-Institute of Organic Farming, Trenthorst, 17th & 18th February 2020. [Completed]

Le Cozler, Y.; Dishenhaus, C.; Arnaud, E.; Beugnet, L.; Charleuf, M.; Denis, P.; Roig-Pons, M.; Pomiès, D.; Martin, B.; Chassaing, C. and Michaud, A. (2018) **A descriptive study of natural nursing procedures in French dairy farms.** In: *Proceedings of the 10th International Symposium on the Nutrition of Herbivores*, Cambridge University Press, 9 (3), p. 692.

Michaud, A.; Cliozier, A.; Bec, H.; Chassaing, C.; Disenhaus, C.; Drulhet, T.; Martin, B.; Pomiès, D. and Le Cozler, Y. (2018) **Déléguer l'allaitement des veaux laitiers aux vaches ? Résultats d'enquêtes auprès des éleveurs.** [Delegating dairy calf feeding to cows? Results from a survey of French farmers.] In: *Rencontres autour des Recherches sur les Ruminants*, 24, pp. 66-69.

Puppel, Kamila; Sakowski, Tomasz; Grodkowski, Grzegorz and Stachelek, Magdalena (2019) **Changes in colostrum bioactive components depend on cytological quality.** In: *Book of Abstracts of the 70th Annual Meeting of the European Federation of Animal Science*, 25, p. 544.

Spengler Neff, Anet (2021) **How do separation and weaning work with little stress? How can we achieve reliable performance testing of dams that are suckled.** Paper at: Workshop ProYoungStock / GrazyDaisy, Online, 30.09.2021. [Completed]

Spengler Neff, Anet (2021) **Milchkontrolle bei Kühen mit muttergebundener Kälberaufzucht.** Workshop at: Workshop zur Milchkontrolle bei Kühen mit muttergebundener Kälberaufzucht, online, 24.9.2021. [Completed]

Vaarst, Mette; Roderick, Stephen; Martin, Guillaume; Gunnarson, Stefan; Spengler Neff, Anet; Grete Kongsted, Anne and Bieber, Anna (2021) **Strategies And Visions For The Future Of Organic Animal Farming.** Paper at: Organic World Congress 2021, Science Forum: 6th ISOFAR Conference co-organised with INRA, FiBL, Agroecology Europe, TP Organics and ITAB, Rennes, France, 8 - 10 September, 2021. [Completed]

Vaarst, Mette; Roderick, Stephen; Martin, Guillaume; Gunnarson, Stefan; Neff, Anet Spengler; Bieber, Anna and Kongsted, A.G. (2020) **Potentials, challenges and visions for future European organic animal farming.** In: Schmid, Otto; Johnson, Marion; Vaarst, Mette and Früh, Barbara (Eds.) *Proceedings of the Organic Animal Husbandry systems – challenges, performance and potentials*, pp. 11-22.

Wildemann, Theresa; Herrmann, Hans-Joachim and Ivemeyer, Silvia (2020) **Vereinbarkeit von muttergebundener Kälberaufzucht und automatischen Melksystemen – Einfluss einer Sperrzeit auf die Saugdauer, Saughäufigkeit und das Fremdsaugen der Kälber.** [Compatibility of a cow-calf-system and robotic milking – effect of blocking period on calves' sucking duration and frequency on mothers and other cows (foster cows).] In: KTBL (Ed.) *Aktuelle Arbeiten zur artgemäßen Tierhaltung 2020*, Kobra, Kassel, KTBL-Schrift, no. 520.

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Schmid, Otto; Johnson, Marion; Vaarst, Mette and Früh, Barbara (Eds.) (2021) **Organic Animal Husbandry systems – Ways to improvement.** IAHA Animal Husbandry Alliance pp. 1-129. Proceedings of IAHA Pre-Conference on Organic Animal Husbandry, Rennes, France + virtual, 6th-7th September 2021.

Schmid, Otto; Johnson, Marion; Früh, Barbara and Vaarst, Mette (Eds.) (2020) **Organic Animal Husbandry systems – challenges, performance and potentials-Proceedings of the IAHA Video-Conference on Organic Animal Husbandry - 21. and 22. September 2020 linked to the 20th Organic World Congress of IFOAM 2021.** 3 p. 1. Proceedings of IAHA Video-Conference on Organic Animal Husbandry, video, 21. and 22. September 2020. [Completed]

Report

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Bieber, Anna; Stamilla, A.; Priolo, A.; Luciano, G.; Spengler Neff, A. and Natalello, A. (2021) **Report: Deliverable 3.2 Effects of mother-bonded calf rearing on meat quality in calves.** .

Grundin, Johanna; Eriksson, Hanna; Fall, Nils; Knierim, Ute; Ivemeyer, Silvia; Simantke, Christel; Bieber, Anna; Spengler Neff, Anet; Fuerst-Waltl, Birgit; Winckler, Christoph; Martin, Bruno; Pomiès, D.; Coccamo, Margerita; Priolo, Alessandro; Sakowski, Tomasz and Alvåsen, Karin (2019) **Review of the regulations concerning organic dairy calf rearing in seven European countries.** , Uppsala.

Ivemeyer, Silvia; Simantke, Christel and Knierim, Ute (2021) **ProYoungStock: Förderung von Gesundheit und Wohlbefinden bei Jungtieren und Milchkühen durch natürliche Fütterungssysteme.** [ProYoungStock: Promoting young stock and cow health and welfare by natural feeding systems.] Universität Kassel, D-Kassel, Fachbereich 11 Ökologische Agrarwissenschaften - Fachgebiet Nutztierethologie und Tierhaltung.

Martin, Bruno; Nicolao, Alessandra; Pomiès, Dominique; Mathieu, Anna; Koczura, Madeline; Bouchon, Matthieu; Constant, Isabelle; Fall, Nils; Eriksson, Hanna and Alvåsen, Karin (2021) **Deliverable 2.1 Keeping cow and calf together – impacts on animal performances, behaviour, welfare and farm economy (INRAE, SLU).**

Martin, Bruno; Nicolao, Alessandra; Pomiès, Dominique; Mathieu, Anna; Koczura, Madeline; Bouchon, Matthieu; Constant, Isabelle and Popova, Milka (2021) **Report: Deliverable 2.2.1 Keeping cow and calf together – impacts on gut microbiota development (INRAE).** Core Organic - ProYoungStock .

Musati, Martino (2019) **Impact of roughage feeding and pasture strategies on health traits of heifers and cows (Work Package 4).** ProYoungStock, National Research Institute for Agriculture, Food and Environment (INRAe).

Schneider, Claudia; Bieber, Anna; Spengler Neff, Anet and Ivemeyer, Silvia (2021) **Separation and weaning of calves reared in cow-calf contact systems.** ProYoungStock - Practice Abstract. Research Institute of Organic Agriculture FiBL, CH-Frick and University of Kassel, D-Witzenhausen.

Schneider, Claudia; Bieber, Anna; Spengler Neff, Anet and Ivemeyer, Silvia (2021) **Trennen und Absetzen von Kälbern in der kuhgebundenen Aufzucht.** ProYoungStock - Practice Abstract. Forschungsinstitut für biologischen Landbau FiBL, Ch-Frick und Universität Kassel, D-Witzenhausen.

UCat, Italy and INRA, France (2019) **D 5.1 Report: Selection of the sources of plant bioactive compounds.** .

Book

Spengler Neff, Anet; Schneider, Claudia; Ivemeyer, Silvia; Bigler, Martin; Bindel, Barbara; Haeni, Robert; Hurni, Beatrice; Knösel, Mechthild; Löffler, Thomas; Lutke Schipholt, Herman; Maier, Alexandra; Mika, Peter; Müller, Christian; Müller, Dorothee; Oswald, Hans; Ott, Martin; Rist, Michael; Schmid, Rochus; Sperling, Urs; Streiff, Ricco; Wälle, Andi; Maeschli, Ariane; Volanti, Marcello; Santini, Sujen; Caccamo, Margherita; Petriglieri, Saro and Ferrera, Stefano (2020) **Allattamento naturale dei vitelli con la madre o una balia negli allevamenti di bovini da latte.** FiBL-Merkblatt. Forschungsinstitut für biologischen Landbau FiBL, CH-5070 Frick.

Spengler Neff, Anet; Schneider, Claudia; Ivemeyer, Silvia; Bigler, Martin; Bindel, Barbara; Haeni, Robert; Hurni, Beatrice; Knösel, Mechthild; Löffler, Thomas; Lutke Schipholt, Herman; Maier, Alexandra; Mika, Peter; Müller, Christian; Müller, Dorothee; Oswald, Hans; Ott, Martin; Rist,

Michael; Schmid, Rochus; Sperling, Urs; Streiff, Ricco; Wälle, Andi; Maeschli, Ariane and Lipka, Martin (2020) **Élevage des veaux sous la mère ou avec une nourrice en production laitière.** Fiche technique. Institut de recherche de l'agriculture biologique FiBL; Demter; Bio Suisse, CH-Frick.

Spengler Neff, Anet; Schneider, Claudia; Ivemeyer, Silvia; Bigler, Martin; Bindel, Barbara; Haeni, Robert; Hurni, Beatrice; Knösel, Mechthild; Löffler, Thomas; Lutke Schipholt, Herman; Maier, Alexandra; Mika, Peter; Müller, Christian; Müller, Dorothee; Oswald, Hans; Ott, Martin; Rist, Michael; Schmid, Rochus; Sperling, Urs; Streiff, Ricco; Wälle, Andi; Maeschli, Ariane and Lipka, Martin (2020) **Odchów cieląt przy matkach i krowach mamkach w ekologicznym stadzie bydła mlecznego.** FiBL-Merkblatt. Forschungsinstitut für biologischen Landbau FiBL, CH-5070 Frick.

Thesis

Bec, Hélène (2018) **L'allaitement maternel du veau laitier.** Masters thesis, ProYoungStock, Institut National de la Recherche Agronomique (INRA), Saint-Genès-Champanelle. [Completed]

Benner, Jana Tabea (2021) **Einfluss der Tränkemenge auf die Gewichtsentwicklung und Gesundheit von weiblichen Aufzuchtkälbern.** Master-Projektarbeit thesis, Universität Kassel, FB 11, Fachgebiet Nutztierethologie und Tierhaltung . Projektarbeit. [Completed]

Di Raimondo, Valeria (2019) **Qualità del latte di vacche modicane alimentate con tannini.** [Quality of milk from modicana cows fed with tannins.] Master thesis, University of Catania, Italy, Department Di3A, via Valdisavoia 5, 95123 Catania, Italy. [Completed]

Fraatz, Undine (2018) **Verleich von Videoaufzeichnungen und Direktbeobachtung zu gegenseitigem Besaugen und Vokalisation von Kälbern.** Thesis, Universität Kassel, FB 11, Fachgebiet Nutztierethologie und Tierhaltung, D-Witzenhausen. Bachelorarbeit [Completed]

Franco, Cristina (2020) **Effetti di un estratto di tannini e della stagione di pascolamento sulla capacità antiossidante del latte di modicana.** [Effects of a tannin extract and grazing season on the antioxidant capacity of modicana cow's milk.] Master thesis, University of Catania, Italy, Department Di3A, via Valdisavoia 5, 95123 Catania, Italy. [Completed]

Furzynski, Sakia (2019) **Die Auswirkungen von unterschiedlichen Tränkemengen auf das Verhalten von Kälbern. Eine Literaturrecherche.** [The effects of feeding different milk amounts on the behaviour of calves – a review.] Thesis, Universität Kassel, Fachgebiet Nutztierethologie und Tierhaltung, D-Witzenhausen. Bachelorarbeit. [Completed]

Gundersen, Sofia (2020) **Strategies for keeping cow and calf together in six European countries.** Masters thesis, Swedish University of Agricultural Sciences, Clinical Sciences. SLU Epsilon, Uppsala.

Iuculano, Antonino (2019) **La qualità del latte di bovine modicane alimentate con una dieta contenente tannini.** [The quality of modicana cow's milk fed on a diet supplemented with tannins.] Master thesis, University of Catania, Italy, Department Di3A, via Valdisavoia 5, 95123 Catania, Italy. [Completed]

Jannerman, Karin (2021) **Ko och kalv tillsammans i mjölkproduktion - fältförsök på två ekologiska gårdar.** [Cow and calf together in dairy production - a field study on two organic farms.] Master thesis, ProYoungStock, Swedish University of Agricultural Sciences - Veterinary programme, Clinical Sciences, Uppsala. [draft]

Jonsson, Karin (2019) **Inventering av uppfödningssystem som tillåter ko-kalvkontakt i svenska mjölkbesättningar Inventory of young stock rearing systems allowing cow-calf contact in Swedish dairy farms.** Master thesis, Swedish University of Agricultural Sciences , Clinical Sciences. Master thesis in Veterinary Medicine, no. EX0869 2019. SLU, Uppsala.

Mathieu, Anna (2019) **Conséquences zootechniques, sanitaires et comportementales de trois modalités d'allaitement du veau laitier.** PhD thesis, ProYoungStock, ONIRIS - Ecole Nationale Vétérinaire, Agroalimentaire et de l'Alimentation. [Completed]

Monticchio, Benedetta (2020) **Effetto di un estratto di tannini e della stagione di pascolamento sulla composizione acidica di formaggi di Modicana.** [Effects of a tannin extract and grazing season on the fatty acid profile of modicana cow's cheese.] Master thesis, University of Catania, Italy, Department Di3A, via Valdisavoia 5, 95123 Catania, Italy. [Completed]

Nicolao, Alessandra (2018) **Suckling of dairy calves by their dams: consequences on animal performances, behaviour and welfare.** Master thesis, ProYoungStock, Universita degli studi di Padova, Dipartimento di Agronomia Animali Alimenti Risorse Naturali e Ambiente. . [Completed]

Pittalà, Sara (2019) **Effetto dei tannini condensati e idrolizzabili sulla qualità del latte di bovine modicane.** [Effect of condensed and hydrolysable tannins on the quality of "modicana" cow's milk.] Master thesis, University of Catania, Italy, Department Di3A, via Valdisavoia 5, 95123 Catania, Italy. . [Completed]

Preußer, Johanna (2020) **Einfluss der Tränkemenge auf das Verhalten von Aufzuchtkälbern.** Bachelorarbeit thesis, Universität Kassel, FB 11, Fachgebiet Nutztierethologie und Tierhaltung. Bachelorarbeit. [Completed]

Preußer, Johanna (2020) **Einfluss der Tränkemenge auf die Gewichtsentwicklung und die Gesundheit von weiblichen Aufzuchtkälbern.** Bachelor-Projektarbeit thesis, Universität Kassel, FB 11, Fachgebiet Nutztierethologie und Tierhaltung . Projektarbeit. [Completed]

Preußer, Johanna (2019) **Gegenseitiges Besaugen in der Kälberaufzucht im Rahmen des ProYoungStock Projektes.** Bachelor-Praktikumsbericht thesis, Universität Kassel, Fachgebiet Nutztierethologie und Tierhaltung. [Completed]

Ritz, Tobias (2019) **Auswirkungen der Tränkemenge in der weiblichen Kälberaufzucht auf Gewichtsentwicklung und Festfutteraufnahme in den ersten 16 Lebenswochen.** [Effects of milk amounts in calf rearing on weight gain and solid food intake in the first 16 weeks of life.] Thesis, Universität Kassel, Fachgebiet Nutztierethologie und Tierhaltung, D-Witzenahusen . Bachelorarbeit. . [Completed]

Schmidberger, Ruth (2020) **Absetzen und Trennen von Kuh und Kalb in der kuhgebundenen Kälberaufzucht Ergebnisse aus dem ProYoungStock - Forschungsprojekt umgesetzt in einem landwirtschaftlichen Fachartikel.** Thesis, Universität Kassel, Fachgebiet Nutztierethologie und Tierhaltung, D-Witzenhausen. Bachelorarbeit. [Completed]

Thiessen, Gesa (2020) **Vergleich von Leistung und Gesundheit von Bio-Milchviehherden mit reiner Frischgras- und Heufütterung und Herden mit Silagefütterung.** Bachelorarbeit thesis, Universität Kassel, FB 11, Fachgebiet Nutztierethologie und Tierhaltung . Bachelorarbeit. [Completed]

Wildemann, Theresa Helena (2019) **Vereinbarkeit von muttergebundener Kälberaufzucht und automatischen Melksystemen – Einfluss einer Sperrzeit vor dem Kuh-Kalb-Kontakt auf die Saugdauer,**

Saughäufigkeit und das Fremdsaugen der Kälber. Bachelorarbeit thesis, Universität Kassel, FB 11, Fachgebiet Nutztierethologie und Tierhaltung . Bachelorarbeit. Kobra, Kassel.

Project description

{Project} ProYoungStock: ***ProYoungStock-Promoting Young stock and cow health and welfare by natural feeding systems.*** Runs 2018 - 2021. Project Leader(s): Spengler, Dr. Anet and Bieber, Anna, FiBL-Research Institute of Organic Agriculture, Frick, Switzerland.

{Project} ProYoungStock: ***ProYoungStock: Förderung von Gesundheit und Wohlbefinden bei Jungtieren und Milchkühen durch natürliche Fütterungssysteme.*** [ProYoungStock: Promoting young stock and cow health and welfare by natural feeding systems.] Runs 2018 - 2021. Project Leader(s): Knierim, Prof. Dr. Ute and Ivemeyer, Dr. Silvia, Universität Kassel, Fachgebiet Nutztierethologie und Tierhaltung, D-Witzenhausen.

Teaching resource

Ivemeyer, Silvia (2019) **Kälber: Fütterung und kuhgebundene Aufzucht.** Thüringer Ökoherz .

Practice tool

{Tool} ***Linseed supplementation for improvement of colostrum quality (Practice abstract ProYoungStock).*** [Suplementacja krów mlecznych siemieniem lnianym w celu poprawy właściwości immunologicznych siary.] Creator(s): Puppel, Kamila; Sakowski, Tomasz; Grodkowski,, Grzegorz and Klopčič, Marija. Issuing Organisation(s): Institute of Genetics and Animal Biotechnology Polish Academy of Sciences, Poland. Practice abstract ProYoungStock. (2021)

{Tool} ***Separation and weaning of calves reared in cow-calf contact systems (ProYoungStock - Practice abstract).*** [Trennen und Absetzen von Kälbern in der kuhgebundenen Aufzucht.] Creator(s): Schneider, Claudia; Bieber, Anna; Spengler Neff, Anet and Ivemeyer, Silvia. Issuing Organisation(s): FiBL - Research Institute of Organic Agriculture. CORE Organic Practice Abstracts. (2021)

Web product

Conte, Giuseppe; Atzori, Alberto Stanislao; Correddu, Fabio; Gallo, Antonio; Natalello, Antonio; Pegolo, Sara and Scerra, Manuel (2021) **ProYoungStock: un progetto per promuovere il legame naturale tra vacca e vitello.** [ProYoungStock: a project to promote the natural mother-calf bond.] RUMINANTIA® Web Magazine del mondo dei Ruminanti è una rivista online regolarmente registrata.. Online at **https://www.ruminantia.it/proyoungstock-un-progetto-per-promuovere-il-legame-naturale-tra-vacca-e-vitello/**, accessed on: 17 August 2021.

Menci, Ruggero (2021) **Allevamento estensivo e tannini: quali sono gli effetti sulla qualità del latte in stagioni diverse?** [Extensive farming and tannins: what are the effects on milk quality in different seasons?] Ruminantia. Online at https://www.ruminantia.it/allevamento-estensivo-e-tannini-quali-sono-gli-effetti-sulla-qualita-del-latte-in-stagioni-diverse/, accessed on: 2 December 2021.

Menci, Ruggero (2021) **Integrare la dieta di vacche da latte con tannini modifica la qualità del formaggio diversamente a seconda della stagione di pascolamento?** [Does supplementing the diet of dairy cows

with tannins change the quality of the cheese differently according to the grazing season?] Ruminantia. Online at **https://www.ruminantia.it/integrare-la-dieta-di-vacche-da-latte-con-tannini-modifica-la-qualita-del-formaggio-diversamente-a-seconda-della-stagione-di-pascolamento/**, accessed on: 17 August 2021.

Video

Alföldi, Thomas and Knösel, Mechthild (2019) **Muttergebundene Kälberaufzucht auf dem Hofgut Rengoldshausen (Video).** Forschungsinstitut für biologischen Landbau (FiBL), CH-Frick .

Bareille, Nathalie; Constancis, Caroline; Pomiès, Dominique; Hellec, Florence and Martin, Bruno (2021) **Webinaire "Repenser l'élevage des veaux laitiers pour rétablir le lien mère-jeune: Étude croisée de l'élevage de veaux sous la mère et de celui sous vaches nourrices".** [Webinar "Rethinking dairy calf rearing to re-establish the dam-calf bond: A comparative approach to rearing calves with the dam or with a nurse cow".] INRAe, Oniris.

Priolo, Alessandro; Spengler Neff, Anet; Martin, Bruno; Licitra, Giuseppe; Petriglieri, Rosario; Coppa, Mauro; Menci, Ruggero; Niderkorn, Vincent; Luciano, Giuseppe and Caccamo, Margherita (2021) **"Workshop ProYoungStock" for Italian stakeholders.** .

This list was generated on **Mon Feb 28 11:41:10 2022 CET**.

4.2 Stakeholders oriented articles in the CORE Organic newsletter

In total the consortium produced the following newsletter contributions:

- https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/proyoungstock-research-for-improved-organic-young-stock-rearing/, 2018.02.01
- https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/natural-nursing-procedures-implemented-in-french-dairy-farms/, https://mailchi.mp/65b75ab6867c/news-from-core-organic-may-1658581?e=[UNIQID], 2019.10.08
- https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/tannin-extracts-to-modulate-ruminant-digestion-and-reduce-environmental-impacts-trials-in-the-proy/, 2020.03.30
- https://projects.au.dk/coreorganiccofund/news-and-events/show/artikel/potentials-challenges-and-visions-for-future-european-organic-animal-farming-across-species/, 2020.09.22
- In December 2021, SE submitted a contribution from WP1 to the CORE Organic newsletter. It will be published in the first issue of 2022.

4.3 Practice abstracts

- Practice Abstract on effects of linseed supplementation on milk quality: https://orgprints.org/id/eprint/42816/ (versions in Polish and English) https://organic-farmknowledge.org/tool/42816
- Practice Abstract on separation and weaning in cow calf contact systems https://orgprints.org/id/eprint/42549/ (versions in German and English) https://organic-farmknowledge.org/tool/42549

4.4 Other dissemination activities and material

***02_UniKassel*:** CCC farmer-experience-exchange messenger group, emerged from series of CCC online webseminars, for German speaking farmers, ongoing beyond project end.

03_IGBZPAN: Polish version of the Technical Leaflet for Mother-Bonded and Fostered Calf Rearing in Dairy Farming:
https://www.igbzpan.pl/uploaded/FSiBundleContentBlockBundleModelTranslatableBlockTranslatableFilesElement/filePath/1644/5153-odchow-cielat-26.05.2020.pdf

06_BOKU: A cooperation with the BOKU project 'Improvement of forage efficiency in grassland based, organic milk production' was possible with regard to hay versus silage feeding. In one experiment, the influence of feeding either hay or silage on milk composition, protein fractions, free amino acids, polyamines and biogenic amines as well as fatty acid profile and sensory properties were analysed. Two scientific papers were published:

van den Oever, SP; Haselmann, A; Schreiner, M; Fuerst-Waltl, B; Zebeli, Q; Mayer, HK; Knaus, W., Hay versus silage: Does hay feeding positively affect milk composition? INT DAIRY J. 2021; 118, 105024 https://doi.org/10.1016/j.idairyj.2021.105024.

A further paper from this cooperation related to the topic hay/silage feeding:
Haselmann, A; Wenter, M; Fuerst-Waltl, B; Zollitsch, W; Zebeli, Q; Knaus, W., Comparing the effects of silage and hay from similar parent grass forages on organic dairy cows' feeding behavior, feed intake and performance. ANIM FEED SCI TECH. 2020; 267, 114560.
https://www.sciencedirect.com/science/article/abs/pii/S0377840120304648

***07_INRAE*:** Additional stakeholder oriented website using ProYoungStock results (https://www6.inrae.fr/projet-coccinelle/) for a participative project of Research-Action in which innovative production systems are tested (with CCC) in an INRAE experimental farm and in private farms involved in a project called Coccinelle. This is coupled with a chat application ("Amiculteurs") involving 70 farmers and to one event (called Radio Cocci) of each month.
Results from Task 2.1 were also disseminated during the conference "*The Science of Artisan Cheese*" held online on the 20th of August 2020 gathering about 200 farmers (http://scienceofartisancheese.com/programme/)

4.5 Future dissemination actions

List of publications/deliverables/activities arising from this project planned for the future:

- Impact of calves reared with foster cows on dairy farms on their health, welfare and veal quality (June 2022 IGBZPAN, UCAT) WP 3.2, **scientific publication**
- Praxiserfahrungen zum Trennen und Absetzen sowie zur stallbaulichen Umsetzung von kuhgebundener Kälberaufzucht [Practical farmers' experience on separating and weaning as well as on housing solutions in cow calf contact systems], article in an organic farmers' magazine 'Lebendige Erde' (January 2022, UniKassel), **farmer-oriented article.**
- Test day recording in suckled cows (Summer, 2022, FiBL), **practice abstract**
- Results of Task 4.2. to be presented at the EAAP 2022 (Aug/Sep, 2022, BOKU), **conference contribution**
- Jannerman, K. 2022. Cow and calf together in dairy production – a field study on two organic farms in Sweden. Swedish University of Agricultural Sciences. (WP2.1) **Master thesis** (defence 2022-01-12)**.**

- Presenting results from WP1.3 “Assessing economic consequences of cow-calf contact systems in dairy production using a stochastic partial budgeting approach” on ISVEE 2022 or EAAP 2022.

Publications/deliverables arising from the project that Funding Bodies could disseminate in the respective national contexts:

- @ CH funding body: make the https://www.bioaktuell.ch/tierhaltung/rindvieh/magka-start.html available in your information channels

Publications/deliverables that could be useful to translate:
The project already contributed to the translation and production of different publications and deliverables and we therefore cannot identify further necessity to translate further material.

4.6 Specific questions regarding dissemination and publications

Is your CORE Organic Cofund project website up-to-date (Please contact the webmaster);
Yes.
List the categories of end users relevant to the research results and how they have been addressed or will be addressed by dissemination activities (Please order them according to the user groups)

- **Farmers and other stakeholders** were addressed by workshops, practice abstracts, leaflets, stakeholder-oriented articles, websites with material, e.g. best-practice movies, and result-feedbacks to the project-participating farmers in the trials and the survey, respectively.

- The **scientific community** was addressed by papers, conference talks/presentations and exchanged their findings within two joint workshops between the researchers of the GrazyDaisy and the ProYoungStock consortium. An additional exchange on WP1 results took place between the GrazyDaisy-team and UniKassel.

5. Project impact

With this project we aimed to answer many research questions on young stock rearing and to exchange our findings and experiences as well as further questions with farmers in all participating countries. The research achievements we had expected are all fulfilled and the end users could well be reached in most countries (except for Slovenia); this aspect even exceeded our expectations:
In WP1 we conducted interviews with 120 farms in 6 countries and analysed 104 of them (Task 1.1). They provided us a good overview on cow calf contact (CCC) systems practised in Europe and laid the foundation for research on economic impacts in Task 1.3 and for the experiments in WP2. The inventory on legislations showed us that there were no obstacles against CCC in Europe (Task 1.2) which no one had really summarized before. Many farmers were involved in Task 1.1 and they were very interested in the results, which have already been published in various farmers’ workshops (DE, CH, and SE) and will be published soon in a scientific journal. The workshops were conducted in presence and as online web-seminars. The online format for workshops induced by the pandemic situation was partly a blessing in disguise because much more participants (268, 164, 147 and 120 participants, about 70% farmers in each of a series of four online workshops within the project) from a broad geographic area could participate in these evening events organised by UniKassel (DE). Workshops in presence had on average about 20 persons per seminar. For farmers it is important to know that in most CCC systems they would need a higher milk price than in conventional systems so to get the same profit from the milk sector as with a conventional system (Task 1.3).

In WP2 we got insights in advantages and disadvantages of different CCC systems which are already practised on farms in Europe (Task 2.1). In WP 1 and in WP 2 we saw that there is no all-fits-one-solution and that each farm has to find own ways to establish a good CCC system. The results from our research will help us to give good recommendations to farmers. They have already been published in workshops for farmers in France

(approx. 400 participants in 3 workshops). That linseed supplementation in cow feed has a great positive impact on colostrum quality was not a big surprise, but a very interesting result showing with how little effort colostrum quality can be ameliorated. This was published in a core organic newsletter, in a practice abstract and in a farmers' magazine in PL ("Hodowca Bydła" 3000 readers) and in Ireland (www.irishorganicassociation.ie) (Task 2.2). In Task 2.3 the question whether CCC systems promote immunity of calves, was answered with "No". No difference could be found in milk nor in calves' serum nor in calves' health traits between twice a day CCC or twice a day teat bucket feeding. But great differences were found between farms underlining that management is most important. Those results will soon be published scientifically.

In WP3 we showed that the effects of enhanced milk amounts fed to calves in a twice daily (teat-) bucket feeding system are smaller than hypothesized: they promoted daily weight gains, but had no or only minor effects on health and behaviour (Task 3.1). Comparing twice a day mother fed to twice a day teat bucket fed calves revealed no significant differences concerning health and production traits. But mother fed calves showed much less cross-sucking. And calves kept permanently with a foster cow additionally showed less manipulation of objects (PL), while on one out of two farms, calves with part-time cow contact even showed more oral manipulations of objects compared to bucket fed calves (CH). Those behaviour disorders indicate welfare deficiencies; therefore, CCC systems have been recommended to farmers in our workshops and farmers' publications (Task 3.2; see also WP 6).

In WP4 no clear advantages of harsh environments during rearing (Task 4.1) nor of silage or silage free feeding (Task 4.2) could be revealed: results were different in different countries, partly because of methodological reasons. Those results will be published country wise. They will not have a great impact on rearing practices.

In WP5 tannin rich plant compounds were detected and their positive impact on milk and cheese quality during hay feeding periods as well as on decreased protein degradation in the rumen was shown. Those results were presented to farmers in a hybrid workshop in Sicily with about 120 participants. They are also published in scientific journals.

In WP6 we published two websites: 1 in PL., 1 in CH containing movies, 1 project information website in SE, and 1 project page in SI.
As there is no one-fits all solution (but there are many pieces of a puzzle). The large variation in management led us to organise many workshops for farmers (DE, CH, IT, PL, SE, SI, FR), so they could exchange on the diverse possibilities of CCC and find out which is the best one for their farm. Those workshops are great to introduce CCC-systems because farmers advise farmers
We wrote 3 technical leaflets on CCC (PL, FR, and IT), 2 practice abstracts (PL, CH/DE), 3 stakeholder-oriented articles (1 PL, 2 DE) and 12 scientific papers, of which 8 are published and 4 submitted to peer-reviewed journals (6 more are planned). Moreover the project contributed to student's education (1 Post doc fellowship, 2 PhD -, 14 Master-, and 7 Bachelor- thesis, plus 3 working papers). We organised two joint workshops with the GrazyDaisy-team to exchange results and discussion points. All these publications are accessible via www.proyoungstock.org and are listed in Organic Eprints (https://www.orgprints.org/).

6. Added value of the transnational cooperation in relation to the subject

The transnational cooperation was very helpful and successful in a project like this one, because we wanted to find out, how cow-calf contact (CCC) systems are carried out in different environments in different regions of Europe. Except the traditional system with Modicana cows in Sicily and the absence of any CCC system in Poland, we found out that independent from country farmers decided individually how they wanted to carry out their CCC system, and the systems were very diverse, but the diversity was similar in each country. Also, the inventory on European and national legislations was so much easier to carry out than within an only national project. All partners could profit from the introduction of the traditional Modicana-milking and

manual cheese making concept in Sicily during the initial project meeting in Catania and surroundings. We are sure that the cooperation in this project could awaken some interest in CCC in Poland, where experiments with foster cows had taken place and where this system had not been known before. Cultural exchange during the midterm meeting in Poland and during the first meeting in Sicily was - as always – very good.
Within this project some students got the opportunity to carry out parts of their PhD in different countries: a close cooperation took place between Italy and France.
Exchange concerning research methods was very helpful, especially because not every partner had the same research facilities like laboratories, research farms or on-farm-research possibilities. For example, for Swiss and Polish researchers it was helpful to send meat samples to Italy for analyses and for Swiss researchers it was good to get the opportunity to analyse milk- and serum samples in France. For Italian researchers it was interesting to do in vitro-digestion experiments in France. So, actually research facilities are better used in international projects than in national ones and it is more efficient if not every institute has to install all the facilities. Because at the same time another Core Organic ERA-Net-project with similar aims - GrazyDaisy - was being carried out, we had regular contact and we organised two joint workshops at the end of the last project year. We exchanged results and discussed open questions together with other research groups and consultants working in the area of CCC systems. Financially we could not see an advantage in international cooperation, except the mutually provided use of facilities and equipment.
The limits of transnational cooperation became clear in the attempts to involve the Slovenian partner. We could repeatedly not reach the responsible person for a long time and often we could not motivate her to contribute what she had promised. Transnational cooperation can be difficult if communication does not work: the distances are long and due to Covid it was not possible to meet at all during the last two years.

7. Suggestions for future research

There should be more research on calf fattening or calf rearing for fattening. CCC systems with dams or foster cows could be very attractive (as we could see) for that sector, but should get better established. Housing systems with CCC have to be developed and the ones that are already developed should be better exchanged between farmers internationally. More farmers' workshops on these subjects are needed. Up to now there exists no international guideline on performance testing in CCC systems; this has to be developed. It would be good to develop a mathematical formula to calculate the amount of milk the calf drunk; so to add that amount to the milked milk a cow had given. The impact of silage feeding on health and fertility traits of cows should be explored closer and on experimental farms as well. The research on plant bioactive compounds like tannins should be extended. In different European regions different tannin rich feedstuffs like residuals from the food industry should be detected and examined concerning their impact on ruminant digestion, methane emissions, protein degradability, and milk quality.