Issue N° 1 - December 2018

IDF

DAIRY SUSTAINABILITY OUTLOOK

Research progress | Global insights | Expert opinion

© DeLaval

© Afimilk

PREFACE

MESSAGE FROM THE IDF DIRECTOR GENERAL

The contribution of milk and dairy products production, processing and consumption to achieve nutrition and socio-economic improvement goals is widely recognized. The dairy sector has been acknowledged for its leading role in sustainable practices for several years. Finding new ways to reduce its impact on environment, manage resources efficiently and increase its benefits to biodiversity and bio-economy is a crucial part of the commitment of the sector for continuous improvement.

Sustainable development is a collective effort that depends on collaboration between international organizations, governments, and the private sectors, as well as individuals. IDF recognizes the challenges and opportunities and is committed to contribute with relevant scientific information and good practices.

This first International Dairy Federation (IDF) Dairy Sustainability Outlook aims at providing an outlook on sustainable development of relevant importance for the dairy sector. It offers an opportunity for those involved in the field to share ongoing projects and new research on sustainability of importance for the dairy sector and contributions to the SDGs.

We would like to thank the authors of this first issue, whose written contributions have helped to add value to this report through their insights and analysis.

Caroline Emond
IDF Director General

MESSAGE FROM THE SCIENTIFIC EDITORS

Dear Reader,

It is an honour to present the 1st edition of the IDF Dairy Sustainability Outlook. In this issue we present articles on sustainable dairying taking place in difference countries, an overview of some global sustainability initiatives, and some research outcomes.

We wish all of you an interesting and informative reading.

Natalie Jones
Member of IDF Chile
njones@consorciolechero.cl

And

Dr María Sánchez Mainar
IDF Science and Standards Manager
msanchezmainar@fil-idf.org

CONTENTS

© CNiEL

NEWS FROM IDF MEMBER COUNTRIES

Germany: Dairy Sustainability Tool

KEYWORDS:
SUSTAINABLE DAIRY FARMING, MONITORING-TOOL, SUSTAINABLE DEVELOPMENT, MULTI-STAKEHOLDER PROCESS, SECTOR-SPECIFIC CONCEPT

ALIGNMENT WITH SDGS:
THE MAJOR SDG'S ARE:

BACKGROUND

Sustainability is gaining more and more importance in the production, processing and marketing of food at national and international level. This also applies to the German dairy industry. In the past, sustainability initiatives were mainly focused at the level of dairy processors. Fields of action include energy-saving measures, steps to reduce water consumption, optimisation of routes for milk collection and reductions in packaging materials. Nowadays, the focus is increasingly shifting towards the whole value-added chain. Consumers, society, food retailers and food companies, internationally and national, want to know how sustainable milk production at farm level in the German dairy industry is. Yet, the inclusion of dairy farms within the dairy-processor specific sustainability concept poses particular challenges. On the one hand, there is a large number of dairy farms and with very different production conditions. In Germany, agriculture takes place under the open sky, so external effects have to be considered. On the other hand, it implied the recording at dairy farm level of a very broad range of sustainability aspects covering economic, ecological and social issues as well as animal welfare. Yet, so far there are scarcely any simple workable and cost-effective means to measure sustainability at dairy farm level in its entirety.

Development of a monitoring tool for measuring and validating the sustainability of dairy farms

A basic-tool for monitoring the sustainable

> "The idea of the *Dairy Sustainability Tool* is to serve as a basic tool for an initial illustration of sustainability aspects at dairy farm level"
>
> **Tomke Lindena**

development of dairy production in Germany was developed. The aim was to measure and assesses a broad range of sustainability criteria in a large number of farms, in order to:

- be able to provide information to business partners or to the society regarding strengths and weaknesses of dairy farms concerning sustainability criteria
- and on basis of all the information gained, to support the sustainable development of dairy farming.

The so-called "Dairy Sustainability Tool" builds upon three previous studies (Flint et al., 2016, Lassen et al., 2014, 2015). Applying a transdisciplinary approach these studies discussed and agreed sustainability criteria (Table 1) and their respective assessments/ratings (Table 2) with different stakeholders from the dairy business in several workshops. Stakeholders were managers of dairy farms, representatives of dairies, agricultural associations and environmental and animal welfare NGOs, agricultural extension services, food retailers, food industry and several scientists. The following requirements were applied when selecting the criteria, including their assessment: they needed to be scientifically defined and validated and at the same time to be measured and collected at a reasonable cost and time period by the farmers, using a written questionnaire. To make the tool cost-effective and applicable to many dairy farms, mainly indirect/driving-force indicators were used. Sustainability criteria and their respective ratings were identified based on: scientific literature reviews, international frameworks (e.g. SAI, DSF), results from existing assessments of sustainability criteria in other measurement systems and on existing legislative frameworks with respect to the criteria.

As a result, the tool consists of (a) a questionnaire for measuring more than 60 sustainability criteria, (b) factsheets with explanations (background and status-quo) of every sustainability criteria and their respective ratings and (c) a web-based questionnaire as well as (d) a database.

HOW IS THE TOOL USED?

The dairy processors interview their milk producers with the questionnaire of the "Dairy Sustainability Tool". Usually, milk producers themselves enter the data into the central database using the web-based questionnaire. Data are then checked for plausibility and analysed by the Thünen Institute. Each dairy processor receives a comprehensive report of the results. Additionally, results are presented internally to the dairy processor. Together, the facts about the status quo are examined and discussed. Strengths and weaknesses of dairy farms regarding the broad range of sustainability criteria are identified, as well as potential for improvements (also by using farm individual benchmarks; see Tab. 2). On basis of all the information gained, goals for the further development of sustainable dairy production are formulated and possible measures for implementation are developed. First experiences show that already by filling in the questionnaire farmers start to reflect about the sustainability of their own farm.

Economy	**Liquidity** • Systematic planning of liquidity **Profitability** • Life-effectiveness of culled cows (kg of milk per day) • Satisfaction with the economic situation of the (dairy) farm in the past three years **Stability** • Changes in equity of the last three years • Investments in dairy production • Hedge/safeguard of farm in case of a long-term illness, etc. • Hedge/safeguard of various risks • Further education and training of the manager • Use of socio-economic consulting/advice • Use of production-related consulting/advice • Existence of the dairy farm in ten years
Ecology	**Cultivation/management of permanent pasture** • Conversion of permanent pasture to arable land in the past five years • Ploughing of grassland in terms of maintenance measures in the past five years **Ecologically valuable land, cultural landscape and preservation of landscape** • Share of extensive pastures • Participation in contractual environmental and nature conservation measures • Share of landscape features, ecologically valuable land and extensive pastures (share of UAA) • Preservation of landscape: maintenance measures **Management of arable land** • Percentage of arable land covered in winter **Nutrient management** • Average nitrogen balance of the last three years • Average phosphorous balance of the last six years • Monitoring the nutrient contents of the soil • Analysis of silage in terms of crude protein content, taking crude protein contents into account while planning the fertilisation • Analysing the nutrition contents (N, P, K) of organic fertilizer **Manure management** • Type of slurry storage (and residual fermentation storage) • Storage capacity (in month) • Application methods of manure and fermentation residue/digestate from biogas plant (on arable land and pastures) **Plant protection management** • Share of pasture not treated pesticides or only partly treated (single weeds) **Energy production and energy consumption** • Regenerative energies: own regenerative energy production or participation in regenerative energy production • Participation in energy checks in the past five years • Energy-saving measures in milk production and milk chilling
Social criteria	**Individual work situation of the manager** • Workload • Satisfaction with the personal work situation • Individual work situation at the farm • Free days per week • Frequency of holidays and number of leave days **Individual work situation of permanent employees in fulltime positions** • Average of weekly working hours • Number of leave days **Employment situation and socio-occupational safety** • Possibility for permanent staff to introduce their own ideas • Wage of the farm workers • Compensation for overtime work • Opportunity of special training/further education for farm workers **Social integration** • Activities for youth development (apprentice, trainee) • Public relations activities • Involvement in work-related civic service/voluntary work • Volunteering for non-agricultural civic service/ voluntary work
Animal welfare	**Rearing methods and cow well-being** • Freedom of movement of the dairy cows • Type of cubicle and the floor covering; management of the lying areas • Cow per resting spot ratio • Cow per feeding areas spot ratio • Access to water • Inspection and cleaning of the drinking trough • Availability of a calving pen; management of the calving pen: ground material and litter; cleaning management • Area for sick cows • Elements for cow comfort **Animal health** • Udder health (status quo): somatic cells • Strategies for drying off • Udder health management: maintenance of the milking system • Cow-individual control of lameness • Prevalence of lameness • Control of joint injuries • Frequency of hoof care • Analysis of the dairy cows' metabolism: no of cows with fatprotein-ratio > 1,5 or fat-protein-ratio < 1,0 • Calculation of daily feed rations • Dairy cows mortality rate • Calf mortality • Antibiotics: use of antibiotics for treatment of mastitis • Application of hormones • Method of dehorning **Additional indicators** • Herd care by external consultants (e.g. veterinarians) • Share of difficult calving • Calf rearing management: supply of colostrum, water and solid feed • Calf rearing system: resting area for new-born calves

Table 1 – Ecological, economic, social and animal-welfare criteria included in the monitoring-tool

The idea of the “Dairy Sustainability Tool” is to serve as a basic tool for an initial illustration of sustainability aspects at dairy farm level. It can be seen as a starting point to create awareness for a more sustainable development among a large number of dairy farms and as an instrument for a continuous learning and development process.

PILOT PROJECT: IMPLEMENTATION AND FEASIBILITY OF THE “DAIRY SUSTAINABILITY TOOL”

The overall objective of the pilot project is to put the “Dairy Sustainability Tool” into practice on a large scale for the first time and to check its feasibility and recognition at all stages of the value chain. Additionally, due to constantly new scientific findings and practical experiences, the tool will be continuously improved based on the knowledge gained. As a result, there should be an outwardly transparent industry solution for the sustainable development of dairy production in Germany, which is suitable for wider successful dissemination.

The pilot project has four major activities:

1. Implementation and testing the “Dairy Sustainability Tool”: The 34 dairy processors use the tool as described above.
2. Checking the international connectivity of the “Dairy Sustainability Tool”: sustainability concepts of international initiatives and selected dairy processors will be examined. The aim is to investigate national and international sustainability activities at the level of the dairy industry in order to be able to situate the “Dairy Sustainability Tool” within a national and international context and to make recommendations for the further development of the tool.
3. Examining the practicability and acceptance of the “Dairy Sustainability Tool”: In an evaluation the perspectives of the participating dairy processors and their milk producers as well as retailers, processing industry, science and NGOs on the so far implemented concept and the associated activities will be examined. These results will be considered in the revision of the tool.
4. Developing a future-proof concept: For the further development of the “Dairy Sustainability Tool”, workshops will be held by the end of 2019 with external participants from science and agricultural extension services, representatives from companies along the dairy value chain as well as environmental and animal welfare NGOs. Based on these workshops and all other project modules, the various components of the module will be revised.

The pilot project started in February 2017 and will last until 2020. Project partners are the Thünen Institute for Farm Economics, QM-Milch e. V. as well as the Land und Markt project office. 34 German dairy processors take part in the project, either with all or a part of their dairy farms.

OUTLOOK: FIRST YEAR RESULTS

During the first year of the pilot project more than 10 dairy processors collected data from over 4000 dairy farmers. The dairy processors are now starting an internal process to deal with the results of the status quo analysis: discussing the strengths and weaknesses of the sustainability of the farms, formulating goals for the further development of sustainable dairy production and developing possible measures for implementation. To get a first impression of sustainable dairy production at country level, an analysis of all data collected is expected by the end of 2018.

> “Due to constantly new scientific findings and practical experiences, the tool will be continuously improved based on the knowledge gained”
> **Tomke Lindena**

The resulting dataset is unique as it provides detailed information about relevant sustainability aspects of a large number of dairy farms. Multivariate statistical methods will be therefore used for the in-depth scientific analyses.

AUTHORS

Tomke Lindena, Anna-Sophie Claus, Heike Kuhnert, Birthe Lassen and Hiltrud Nieberg
Johann Heinrich von Thünen Institute
tomke.lindena@thuenen.de

REFERENCES

Flint, L.; Kuhnert, H.; Laggner, B.; Lassen, B.; Nieberg, H.; Strohm, R. (2016). Prozess nachhaltige Milcherzeugung – Entwicklung eines Nachhaltigkeitsmoduls zur Erfassung und Bewertung von Nachhaltigkeitskriterien auf milchviehhaltenden Betrieben. Working Paper 54, Johann Heinrich von Thünen-Institut. Braunschweig: Johann Heinrich von Thünen-Institut. Online available: https://literatur.thuenen.de/digbib_extern/dn056506.pdf

Lassen, B.; Nieberg, H.; Kuhnert, H.; Sanders, J.; Schleenbecker, R. (2015). Status quo-Analyse ausgewählter Nachhaltigkeitsaspekte der Milcherzeugung in Schleswig-Holstein. Working Paper 43, Johann Heinrich von Thünen-Institut. Braunschweig: Johann Heinrich von Thünen-Institut. Online available: https://literatur.thuenen.de/digbib_extern/dn055532.pdf

Lassen, B.; Nieberg, H.; Kuhnert, H.; Sanders, J. (2014). Status-quo Analyse ausgewählter Nachhaltigkeitsaspekte der Milcherzeugung in Niedersachsen. Working Paper 28, Johann Heinrich von Thünen-Institut. Braunschweig: Johann Heinrich von Thünen-Institut. Online available: https://literatur.thuenen.de/digbib_extern/dn053673.pdf

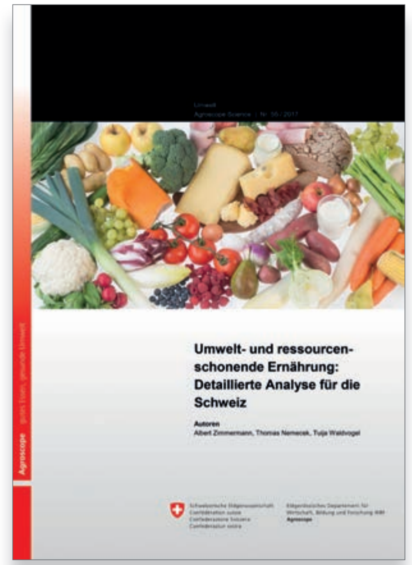
	your farm	excellent	good	satisfactory	unsatisfactory	Number of farms with answers
Stability						
Investments in dairy production in the last five years	Yes		Yes 79%		No 21%	220
Individual work situation of the farm manager						
Workload farm manager	Permanently very high and often above personal limit		Affordable, rather rarely at personal limit 13%	Often high, but still affordable; only occasionally at or above personal limit 63%	Permanently very high and often above personal limit 24%	216
Animal Health						
Somatic cells: percentage of cows with a somatic cell count of less than 100,000 cells/ml in average of the last 12 month	At least 40 % but not more than 60 % of the herd have a somatic cells count less than 100,000 cells/ml	At least 75 % of the herd have a somatic cell count less than 100,000 cells/ml 8%	At least 60 % but not more than 75 % of the herd have a somatic cells count less than 100,000 cells/ml 24%	At least 40 % but not more than 60 % of the herd have a somatic cells count less than 100,000 cells/ml 49%	Less than 40% of the herd have a somatic cell count less 100,000 cells/ml or data are not known 19%	195

Table 2 – Example of a benchmark: selected criteria and their respective ratings; percentage of farms in the different categories

Switzerland: Eco-friendly, resource-conserving food and feed production

KEYWORDS:
ENVIRONMENT, DIET, FOOD AND FEED PRODUCTION, CONSUMPTION, MODELLING

ALIGNMENT WITH SDGS:
THE MAJOR SDG’S ARE:



SUMMARY

Food and feed production, together with its preliminary stages – from the provision of the means of production, through to the growing and processing stages – is associated with significant environmental impacts. Opportunities for reducing these impacts exist at both the production and consumption stages, e.g. through changes in production techniques and diet, respectively. As part of the ‘Green Economy’ strategy, the Swiss Federal Office for Agriculture (FOAG) deals with the challenges and potentials of resource-conserving food and feed production. Here, attention must be paid to the sustainable use of arable land and permanent grassland for food production.

RESEARCH ISSUE

On behalf of the FOAG, Agroscope investigated how a diet for the Swiss population associated with the lowest possible environmental impacts might look like. Prerequisites were compliance with production-related process conditions whilst maintaining a productive domestic agricultural sector, coupled with a needs-based diet. Furthermore, certain additional framework conditions were stipulated in various scenarios.

The following issues were investigated:

- What would a needs-based diet for the Swiss population coupled with a reduction in environmental impacts look like?
- How would this alter agricultural production in Switzerland?
- What effects would this change have on imports and degree of self-sufficiency?
- To what extent could the environmental impacts be reduced?

METHOD

The issue was investigated with the DSS-ESSA model system, used by the Federal Office for National Economic Supply to simulate food crises in Switzerland. This model system looks simultaneously at Switzerland’s agricultural production, imports and exports of food and feed, the processing of the products in question, and the diet of the Swiss population. The model was expanded within the context of the study as follows:

Milk production and grassland use were differentiated according to various levels of intensity.

- Imbalances in the model calculation between the manure generated by the animals and the fertiliser requirements of the crops were evened out by a reduced or increased demand for mineral fertiliser.
- Food loss at the consumption level was included and estimated on the basis of two studies.
- Nutritional requirements were significantly expanded and adapted to the latest findings. Several additional foods such as legumes, tofu or peanuts were included in the model.
- The SALCA life-cycle assessment method was used to determine environmental impacts for all activities depicted in the model, such as production processes and processing operations, or imported products. For this, 512 eco-inventories were used, most of which had to be adapted to or newly created for the DSS-ESSA model. The ReCiPe, Impact World+ and Environmental Impact Points (ecological scarcity method) endpoint methods were used to quantify environmental impacts. In addition, various indicators at midpoint level (e.g. greenhouse potential, eutrophication, ecotoxicity) or individual emissions and resources (e.g. ammonia, methane, phosphorus requirement) were included in the analysis.

The expanded Green DSS-ESSA model therefore investigates a food-supply situation that is optimised in terms of environmental impacts, and that takes into account on the one hand all production and nutritional requirements, and on the other the stipulated production specifications. Coffee and tobacco are not included in the model, as they do not contribute to the nutrient supply. Moreover, environmental impacts associated with the retail trade and consumer food preparation (Figure 1) have to date not been taken into consideration either.

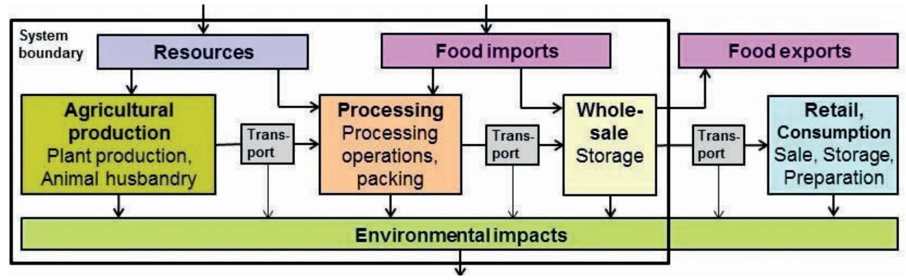


Figure 1 – Food-supply system under consideration

EXAMINED SCENARIOS

The Reference scenario serves as a comparative scenario in the study. It describes the current situation by using the target function to minimise the deviations of the model solution from current production and dietary habits. The Min ReCiPe scenario is optimised in terms of environmental impacts. Depending on the life-cycle assessment method used, the environmental impacts can occur in Switzerland, or – where associated with imports – abroad. Based on the target function of Min ReCiPe, there were additional framework conditions to be complied with in three further scenarios.

- **Reference** Current situation
- **Min ReCiPe** Minimisation of environmental impact of ReCiPe
- **FP** Composition of ration according to food pyramid
- **FP/Cal** Composition of ration and energy intake according to food pyramid
- **FoodWaste** Complete reduction in avoidable food waste during consumption.

Apart from the general model interrelationships, the following additional conditions were to be met:

- Average total calorie intake per person and day remained at the current level, so that the effect of a change in diet combined with unchanging energy supply could be analysed. Only in the FP/Cal scenario did reduced energy intake apply, in line with the relevant dietary recommendation.
- For each food, the current process yields and percentage losses along the food chain were assumed. Only in the FoodWaste scenario was the model permitted to completely reduce avoidable losses during consumption, thereby reducing the quantity of food required with the same intake before deduction of these losses.
- None of the scenarios permitted a further increase in current deviations of the average ration from the dietary recommendations (shopping-cart shares, nutrient supply).
- In order that currently consumed products do not disappear completely from the population's diet, the consumption of all individual foods should not fall by more than 90% of the current quantity in each case.
- Food exports were kept constant in the current configuration; otherwise, the model solution would have led to an export, and hence to a non-imputation of environmentally damaging foods in particular.
- The use of the entire agricultural area of Switzerland was assumed. This condition serves two purposes: on the one hand, products from these areas contribute to supply security; on the other, an open landscape is maintained.

The effect of altered model assumptions was investigated by means of sensitivity analyses, to enable the robustness of the results to be assessed.

RESULTS

Overall, it appears that the environmental impacts of diet can be reduced by over 50% based on the assumptions made (Figure 2). Here, major improvements are possible with practically all environmental impacts. As regards deforestation, largely dispensing with certain imported products such as soya feedstuffs and cacao even allows us to achieve an 80% reduction. Major reductions are also possible for the individual emissions (greenhouse gases and ammonia, -50%; nitrate and phosphorus, -35%). Owing to the higher proportions of milk and vegetables and the lower sugar consumption, compliance with the food pyramid recommendations (FP scenario) leads to a smaller reduction in environmental impacts. By contrast, avoidance of food waste in the household yields a more significant reduction.

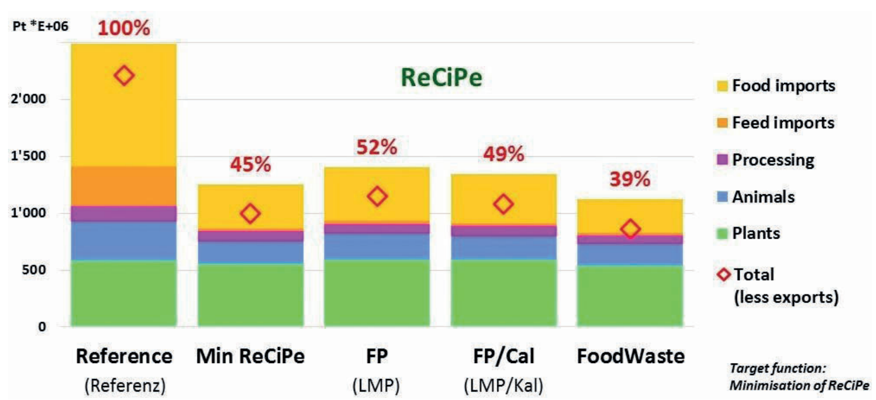


Figure 2 – Environmental impact of ReCiPe (Reference = 100%)

The composition of the average diet changes significantly (Figure 3). Key features of a resource-conserving diet of this sort are a significant drop in the proportion of meat (-70%) and a larger proportion of grains, potatoes or legumes (+35%) as well as oils or nuts (+50%), whilst milk consumption remains at the same level. This result can be explained by the major differences in environmental impacts between animal and plant foods, with milk nevertheless performing significantly more favourably than meat. By contrast, differences among plant foods are frequently very slight. Thus, the replacement of potatoes by grains, or nuts by vegetable oils and grains has very little influence on total environmental impact. The more-resource-conserving diet diverges less strongly from nutritional recommendations than the current diet, especially owing to the former's lower meat and alcohol consumption, and its partial replacement of animal fats with vegetable oils and fats.

In line with the decrease in the proportion of meat in the diet, livestock populations – especially pig, fattening poultry, suckler cow and fattening-cattle numbers – also fall sharply in the model results. Grassland is used for dairy farming, and the proportion of higher-yielding dairy cows increases. Overall, animal populations – measured in livestock units – fall by almost half. Livestock feed rations also change: Cows are fed fresh and ensiled grass, hay, and those with a higher milk yield are also given maize kernels and barley. Thus, protein is increasingly provided via grass, whilst soybean meal, which is associated with high environmental impacts, disappears from the diet. A large proportion of the permanent grasslands is farmed extensively. The low nutrient grass from these lands is fed to the rearing cattle, sheep and goats. The sharp reduction in livestock populations means that feed imports can be largely eliminated. Arable land also continues to be used for forage cultivation, but to a significantly lower extent. Whereas a part of this land is used as temporary leys, which are important for a balanced crop rotation, significantly more grains for the human diet (+70%) are grown on arable land. There is also an increase in the area devoted to potatoes (+140%), vegetables (+100%; in the FP scenario, even +350%) and oilseed rape (+20%).

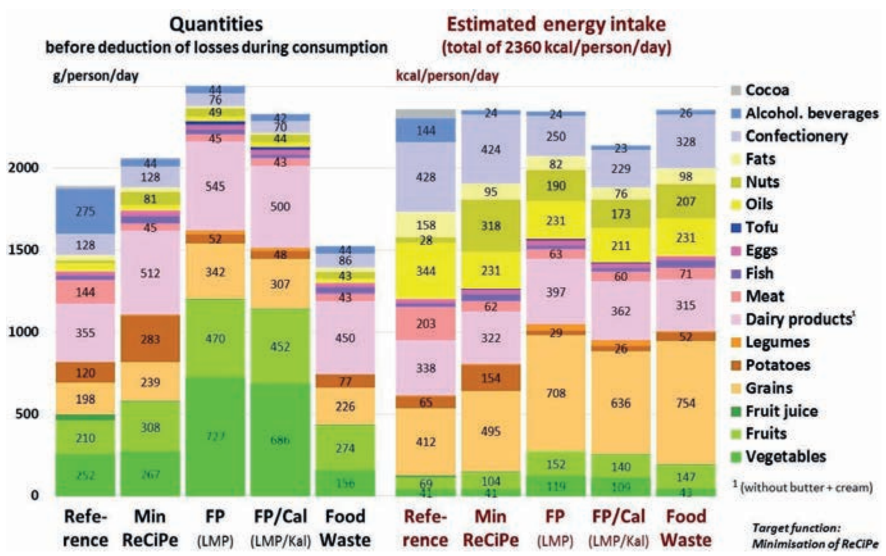


Figure 3 – Average diet in Switzerland

Food imports decrease (-28% in calories), whilst only small amounts of feedstuffs are now imported (-85%). As a result, the percentage of domestically produced products, and hence the degree of self-sufficiency, increases significantly, from 61% to around 80%. The total environmental impacts of imported foods fall by around 70%, and those of foods produced in Switzerland – despite the higher amount of calories produced – by 20% (ReCiPe indicator).

The choice of method for calculating environmental impact had only a slight influence on the result. A similar scale of percentage reduction to that of the ReCiPe indicator (-55%) was also achieved in the case of the minimisation of Impact World+ (-52%), Environmental Impact Points (-60%) and greenhouse potential (-61%). Here, dietary composition trends evolved in the same direction, but with differences for individual products.

> "A systematic focus on protection of the environment and resource conservation enabled the environmental impacts of the Swiss population's diet to be more than halved whilst maintaining the use of all of Switzerland's agricultural land, with unchanged exports and without an increase in existing deviations from dietary recommendations"
>
> **Albert Zimmermann**

CONCLUSIONS

A systematic focus on protection of the environment and resource conservation enabled the environmental impacts of the Swiss population's diet to be more than halved whilst maintaining the use of all of Switzerland's agricultural land, with unchanged exports and without an increase in existing deviations from dietary recommendations.

In order to achieve this, the average composition of the diet had to change substantially, involving on the one hand a significant increase in the consumption of (a) grains or potatoes, (b) nuts, and (c) fruit or vegetables, as well as the maintenance of dairy consumption in a predominantly unprocessed form; and on the other, a sharp reduction in meat and alcohol consumption, as well as a decrease in the consumption of edible oils, durum wheat products, rice, and processed dairy products. Sugar consumption would remain the same or fall on the basis of the nutritional recommendations.

At the same time, production processes would need to be optimised, especially in terms of the feeding of cattle, who would essentially exploit the grassland yields. Concentrates would almost cease to be imported and would only be cultivated domestically on a small scale.

An additional significant reduction in environmental impacts would be possible if we managed to avoid all avoidable food loss. Whilst losses at the production and processing stages are frequently inevitable, there is greater potential for avoiding them at the consumption stage.

An environmentally optimised diet would be accompanied by synergy effects: at the same time, it would largely meet current dietary recommendations. Furthermore, lower import levels would increase our degree of self-sufficiency, thereby reducing Swiss dependence on foreign sources.

All in all, the analysis shows that the current situation is far from the ideal of an eco-friendly, resource-conserving food and feed production system, and that a great potential for improvement therefore exists. In order to derive concrete measures for improvement, detailed investigations requiring a further expansion of the models and data sources used would have to be conducted. Moreover, it might also be necessary to consider economic aspects, depending on the issue examined. Such a far-reaching change in diet, however, would doubtless require the cooperation and willingness of both the population and the economic and policy-making sectors.

AUTHORS

Albert Zimmermann & Thomas Nemecek
Agroscope, Switerland
albert.zimmermann@agroscope.admin.ch
thomas.nemecek@agroscope.admin.ch

REFERENCES

Zimmermann, A., Nemecek, T., Waldvogel, T.2017. Umwelt-und ressourcen-schonende Ernährung: Detaillierte Analyse für die Schweiz. Umwel, Agroscope Science. N 55.

New Zealand: The Sustainable Dairying - Water Accord

KEYWORDS:
DAIRY, WATER, SUSTAINABLE MANAGEMENT PRACTICES, RIPARIAN MANAGEMENT, INDUSTRY PARTNERS

ALIGNMENT WITH SDGS:
THE MAJOR SDG'S ARE:

BACKGROUND

In 2013 New Zealand dairy industry partners launched the Sustainable Dairying Water Accord to enhance the overall performance of dairy farming as it affects freshwater. The Accord represents a common desire of the New Zealand dairy sector to contribute responsibly to protecting, and where opportunities exist, enhancing the many benefits and experiences New Zealanders enjoy in freshwater. This includes swimming, recreation, gathering food, the provision of habitat for aquatic species, as well as the ability to use water for social, cultural and economic betterment.

WHAT IS IT ABOUT?

The Accord focuses on adoption of good management practices, with accountability being maintained through annual independent audits and progress reports. The commitments and targets span five areas of practice relevant for water quality – nutrient management, effluent management, riparian management, water use management, and conversion of land to dairying.

ACHIEVEMENTS OF THE WATER ACCORD

The progress highlights and achievements include:

- 92% of waterways falling under the Accord have dairy cattle excluded – this involves 26,167km of fencing;
- 99.4% of the 44,386 regular stock crossing points on dairy farms have bridges and culverts;
- 13 riparian planting guides have been produced by DairyNZ in partnership with regional councils to assist farmers in undertaking riparian planting to improve water quality;
- 5,701 dairy farms have installed water meters;
- 83% of farmers have nutrient budgets and have received benchmarked information on their nutrient management;
- 133 rural professionals have been certified as nutrient management advisors.

NEXT STEPS

In line with the Plan, Do, Check and Adjust ethos of the global Dairy Sustainability Framework, the New Zealand dairy industry is now reviewing learnings from the first 5 years of this accord with a view to making any adjustments necessary to continue building on current achievements.

AUTHORS
Kimberly Crewther[1], David Burger[2]
[1] DCANZ , [2] Dairy New Zealand
Kimberly.crewther@dcanz.com
david.burger@dairynz.co.nz

REFERENCES

Dairy New Zealand (2018). Sustainable Dairying: Water Accord https://www.dairynz.co.nz/environment/in-your-region/sustainable-dairying-water-accord/ Last accessed 12 December 2018.

GLOBAL INITIATIVES

Dairy Declaration of Rotterdam showing progress

KEYWORDS:
SUSTAINABLE DAIRY FARMING, MONITORING-TOOL, SUSTAINABLE DEVELOPMENT, MULTI-STAKEHOLDER PROCESS, SECTOR-SPECIFIC CONCEPT

ALIGNMENT WITH SDGS:
THE MAJOR SDG'S ARE:

INTRODUCTION

The aim of this paper is to examine the progress of milk production and demand, and its contribution to the Dairy Declaration and the Sustainable Development Goals (SDG's), defined within the UN Agenda 2030. For this reason, four indicators, total milk demand, per capita demand, milk production (cow and buffalo), and average milk yield (cow and buffalo), are monitored within a seven-year time period (2010-2017). Developments are tracked at the global level. In addition, some regional statistics have been included as well, in order to provide illustrative examples of regions showing data markedly higher than the global mean (see Annex for further regional details).

THE CONTRIBUTION OF DAIRY PRODUCTION AND DEMAND GROWTH TO THE SDG'S

Concerning the Agenda 2030, agriculture and consequently dairy plays a vital role in accomplishing several of the 17 Sustainable Developments Goals (SDG's). In examining the development of the different indicators within the time frame of 2010 to 2017, substantial progress related to certain goals can be identified.

Goal 1 No poverty: Between 2010 and 2017 production growth was tracked globally, increasing by an estimated 120 million tonnes of milk, all kinds of milk included, to a level of 849 million tonnes in 2017. Milk production supports good livelihoods, and ultimately the goal of poverty eradication, given the role of dairy farming as both a capital investment and an income stream. Moreover, dairy production, as well as dairy processing, has positive economic impacts through the role production and processing play as job creators, both directly and in the supporting supply chains (IDF, 2014; FAO, GDP and IFCN, 2018).

Goal 2 Zero Hunger: As examined, between 2010 and 2017 consumption of milk and dairy products increased by 120 million tonnes or 7 kg per capita to a level of 113 kg per capita. This clearly shows the increased accessibility and utilization of nutritious food. As a consequence, progress in fighting hunger and undernourishment is achieved, as high growth rates can be observed, particularly in developing regions. The wider availability of dairy products, as evidenced through higher rates of dairy consumption, also indicate improvements in food security.

Goal 3 Ensure healthy lives: Dairy foods are nutrient rich. Nutrient rich foods like milk, cheese and yoghurt provide a lot of nutrients that the body needs, relative to the amount of energy they provide. The importance of dairy foods as part of a healthy diet is reflected in the fact that they are included in dietary recommendations worldwide.

The above-mentioned increase in per capita consumption on a global level, clearly demonstrates progress in ensuring healthy lives. With its high nutritional value, dairy can complement a well-balanced diet and meet essential nutritional needs. Higher levels of animal protein are being accessed by more people around the world, thereby contributing to sound nutrition.


Food and Agriculture Organization of the United Nations

THE DAIRY DECLARATION OF ROTTERDAM
The dairy community accepts sustainability challenge

We, representatives of the one billion person global dairy community, gathered in Rotterdam at the World Dairy Summit, are committed to the sustainable development of the dairy sector to generate widespread benefits for people and the planet.

We recognize:

- the UN 2030 Agenda for Sustainable Development as the overarching framework that guides our actions towards sustainable development from a social, environmental, economic and health perspective;
- the vital role of dairy for food security and poverty reduction and the important livelihood and development opportunities for family farmers, small holders and pastoralists;
- the critical contribution the dairy sector makes to Sustainable Development, including:
  - the essential role of dairy products for balanced, nutritious and healthy diets;
  - the major contribution that dairy makes to countries' economies, income, employment and livelihood
  - the key function of the dairy sector in the management of terrestrial ecosystems and the need to address environmental degradation and climate change, and to support biodiversity;
- the diversity of dairy production systems and dairy breeds, contexts and priorities;
- the need for continuous and open dialogue and joint actions at all levels.

We agree to:

- Take an integrated approach to promote the sustainability of dairy systems, jointly taking into consideration social, economic, health and environmental dimensions;
- Give particular attention to the needs of family farmers, small holders and pastoralists;
- Build, implement and disseminate tools and guidelines to facilitate the identification and adoption of sustainable practices in the dairy sector;
- Build capacity in support of sustainable practices and provide enabling conditions;
- Measure and report on sustainability outcomes.
- Strengthen multi-stakeholder dialogue for consensus building, reviewing progress and continuous improvement.

Rotterdam, 19 October 2016

President, International Dairy Federation asbl

Ren Wang,
Assistant Director General, Food and Agricultural Organisation of the United Nations

Goal 13 Climate action: Between 2010-2017, the global average annual milk yield increased by more than 200 kg of milk per cow and per buffalo to a level of 2500 kg of milk per cow annually (2000 kg per buffalo), or +9,2% for cows' milk, +10.5% for buffalo milk. in total. Generally, high yielding cows produce lower CO2 output per unit output (i.e. kg milk), as the maintenance requirements are spread over a larger amount of milk than for low yielding cows. In consequence, a global increase in milk productivity helps to combat climate change and its impacts. In this chapter, milk yield increase has been chosen as one indicator of this. However, the global dairy sector has been pursuing various actions to reduce the output of greenhouse gasses (IDF, 2017).

DAIRY DECLARATION IN PROGRESS

In line with the abovementioned UN 2030 Agenda for Sustainable Development, the dairy community declared its commitment to "The Dairy Declaration of Rotterdam" embracing its role in meeting the demand for sustainably produced products and confirming the vital role of the dairy sector.

As discussed, in examining the progress in milk production, and milk and dairy demand, great steps forward on some of the Agenda's top goals regarding economic and health dimensions have been made. Between 2010-2017, due to an increased level of total dairy production and demand, a critical contribution on achieving SDGs is visible.

"More people are able to consume dairy products at higher levels, thus contributing to nutritious and healthy diets"

Caroline Emond

Increased total demand and per capita demand indicate that more people are able to consume dairy products at higher levels, thus contributing to nutritious and healthy diets. Additional demand is enabled and provided by increased production. Moreover, increased milk production and productivity provide a significant contribution to income, employment and the livelihood of farmers. In turn, the milk produced is processed into a variety of dairy products, thereby supporting additional jobs throughout the global value chain. Beyond this, an increased global milk yield is one way in which the dairy sector is participating in combatting climate change.

These are just a few of the ways in which the dairy sector is increasingly operating in a sustainable manner to the benefit of people around the world. More than a target, this is a journey, since at all levels of the dairy chain, the global dairy sector is in a continuous process of stimulating and encouraging next steps in pursuing sustainable methods of operation.

MILK DEMAND AND PRODUCTION DEVELOPMENTS

a) Total milk demand and per capita demand

Global milk demand increased by 120 million tonnes of milk (all milk of cow, buffalo, goat, sheep and camel) between 2010 and 2017. Between (2010-2017) milk demand grew by 2.2% per annum (p.a.) on average, tallying a remarkable jump of 16.5%% over that time period (Table 1). Since 2000 the total increase in milk demand has been 46.9%. This demand growth was driven in relatively equal proportions by a hike in per capita demand expansion and by an expanding population. On average, global per capita milk demand increased by 0.9% p.a. and reached a level of 113 kg of milk per capita in 2017. Population growth played a similar role, driving a 1.3% growth rate on average p.a.

b) Milk production and productivity results

Global milk production (cow and buffalo) increased by 2.2% p.a. in the last seven years (2010-2017), reaching a level of 849 million tonnes of milk in 2017 (Table 2). Average milk yield increased by 1.2% p.a., reaching a level of 2500 kg of milk per cow annually (2000 kg per buffalo). Production growth was driven by the increase in dairy animals and by milk yield growth (IDF, 2018).

Global dairy demand growth in percentage / year (CAGR)	2010-2017
Dairy demand*	+2.2%
Population**	+1.3%
Dairy demand per capita	+0.9%

Table 1 – Percentage of global dairy demand growth per year in Compound Annual Growth Rate (CAGR) (IDF, 2018; Population Reference Bureau, 2018)

Global milk production growth in percentage / year (CAGR)	2010-2017
Milk production	+2.2%
Dairy animals	+0.8%
Average milk yield	+1.3%

Table 2 – Percentage of global milk production growth per yea in Compound Annual Growth Rate (CAGR) (IDF, 2018)

METHODOLOGY

When referring to milk and dairy demand, we are discussing apparent consumption. This is due to the fact that no studies of consumption habits based on actual purchases on a global scale are available. Moreover, the informal market accounts for a significant part of the global dairy market. Total consumption can therefore only be assessed using calculations taking into account production, trade, and, where available, stock variation figures.

Demand per capita is calculated by taking milk demand divided by total population.

In light of absence of an agreed IDF methodology pertaining to the calculation of milk equivalents, the methodology utilized by FAO is here employed for the purpose of this report. FAO calculates milk equivalents by using conversion factors based on the following solid content method: 6.6 for butter, 4.4 for cheese, 7,6 for skim/whole milk powder, 1.9 for skim condensed/evaporated milk, 2.1 for whole condensed/evaporated milk, 1.0 for yoghurt, 3.6 for cream, 7.4 for casein, 0.7 for skim milk, 1.0 for liquid milk and 7.6 for dry whey.

Milk production data includes cow and buffalo milk production.

Calculation of the milk yield: milk production of cows and buffalos is divided by the number of milking animals. Milk production data includes cow and buffalo milk production.

"Increased milk production and productivity provide a significant contribution to income, employment and the livelihood of farmers and on additional jobs throughout the global value chain"

Caroline Emond

DAIRY DEMAND

The key findings are:

- Global demand of milk and dairy products increased in absolute numbers by 120 million tonnes of milk (2017 vs. 2010), reaching a level of 851 million tonnes in 2017.
- Developments differed significantly by region (Figure 1). For example: in developing countries fresh dairy products are predominantly consumed, while in contrast in developed countries consumer preferences tend towards manufactured products such as cheese (OECD-FAO Agricultural Outlook 2018-2027)
- Within 7 years (from 2010 to 2017), total milk demand increased by 16.5% This represents an average annual increase of 2.2%.
- The total demand growth of 16.5% increased by through a combination of population growth (9%) and growth in capita demand (7%).

PER CAPITA DEMAND

The key findings are:

- Global per capita demand of milk and dairy products increased by 7 kg per capita/year (2017 vs. 2010), reaching a level of 113 kg per capita/year.
- Within 7 years (2010 to 2017), global per capita demand increased by a total of 7%. This is an average annual increase of 0.9%.

From the OECD-FAO Agricultural Outlook 2018-2027 it can be concluded that (Figure 2):

- Between 2008 and 2017, annual growth rates of per capita consumption for nearly all product categories were substantially higher in developing countries than in developed countries, albeit starting from lower levels;
- Highest growth in developing countries was observed for skimmed milk powder (+3.90% p.a.) and fresh dairy products (+2.09% p.a.);
- While skim milk powder also flourished in developed countries (+2.84%p.a.), in contrast with this, fresh dairy products showed a negative development in the developed countries (-0,73% p.a.)
- Within 7 years, 2010 to 2017, global per capita demand increased on total by 7%. This is an average annual increase of 0.9%.

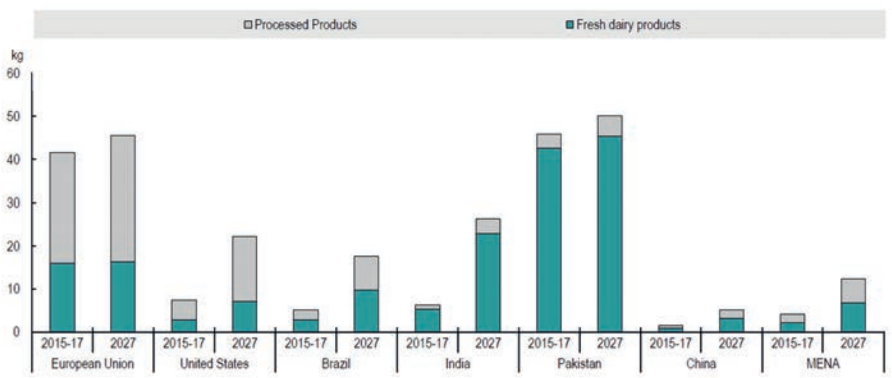


Figure 1 – Per capita consumption of processed and fresh dairy products in milk solids (Milk solids are calculated by adding the amount of fat and non-fat solids for each product; Processed products include butter cheese, skim milk powder and whole milk powder). (OECD and FAO, 2018)

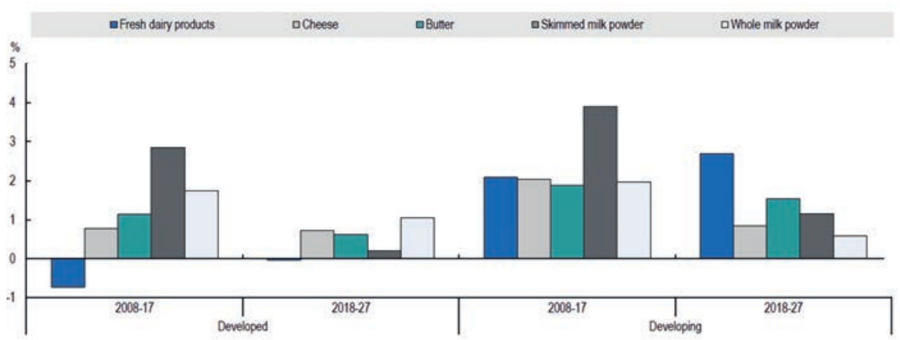


Figure 2 – Annual growth rates of per capita consumption for dairy products (OECD and FAO, 2018)

MILK PRODUCTION COW AND BUFFALO

The key findings are:

- Global milk production of all kinds increased by 120 million tonnes of milk from 2010 to 2017, reaching a level of 849 million tonnes in 2017.
  - An increase of milk production (cow and buffalo) by 75 million tonnes, which is equal to two thirds of the absolute global increase, was generated by Asia.
  - An increase of milk production (cow and buffalo) of 16 million tonnes, which is equal to 13% of the absolute global increase, was generated by the European Union.
- Within 7 years (2010 to 2017), total milk production (cow and buffalo) increased by a total of 16%. This is an average annual increase of 2.2%. In Asia, milk production growth was disproportionally higher than the global average, tallying 3.8% in that region.
- The total production growth of 16% was driven by a combination of milk yield growth (9%) and by increased cow and buffalo numbers (7%).

AVERAGE MILK YIELD OF COWS AND BUFFALOS

The key findings are (IDF, 2018; OEDE and FAO, 2018):

- Global milk yield increased by 0.2 tonne per cow and buffalo (2017 vs. 2010), reaching a level of 2 and 2.5 tonne per buffalo and per cow respectively.
  - The highest increase in milk yield was monitored in North America (898 kg per cow/year).
  - A small decrease in milk yield was monitored in Africa (-30 kg per cow/year).
- Within 7 years (2010 to 2017), global cow's milk yield increased by a total of 8.5%. This is an average annual increase of 1.3%.

ANNEX

Region	Dairy consumption (millon of Milk equivalent[1])			
	2010	2017	2010-2017 Absolute change	2010-2017 Percentage (CAGR)
Asia	277	360	82	3,8%
Europe	205	204	0	0,0%
EU	144	146	2	0,2%
Non-EU	61	58	-3	-0,6%
North America	93	98	5	0,8%
South America	61	63	3	0,6%
Africa	45	54	9	2,7%
Central America	19	22	3	2,0%
Oceania	10	11	1	0,8%

[1] Milk equivalent are calculated using conversion factors based on solid content method described in IDF bulletin 390 of march 2004 (6.6 for butter, 4.4 for cheese, 7,6 for skim/whole milk powder, 1.9 for skim condensed/evaporated milk, 2.1 for whole condensed/evaporated milk, 1.0 for yoghurt, 3.6 for cream, 7.4 for casein, 0.7 for skim milk, 1.0 for liquid milk and 7.6 for dry whey. Compound Annual growth Rate (CAGR)

Table 3 – Dairy consumption by region (million tonnes of Milk equivalent). IDF calculation based on FAO outlook June 2011 and June 2018, this apparent consumption calculation doesn't take into account regional stock variation.

Region	Dairy consumption (millon of Milk equivalent[1])			
	2010	2017	2010-2017 Absolute change	2010-2017 Percentage (CAGR)
Asia	67	80	13	2,6%
Europe	277	274	-3	-0,1%
EU	288	287	-1	-0,1%
Non-EU	254	248	-6	-0,4%
North America	270	271	1	0,1%
South America	156	150	-6	-0,5%
Africa	43	43	0	-0,1%
Central America	99	101	2	0,2%
Oceania	270	253	-18	-1,0%

[1] Milk equivalent are calculated using conversion factors based on solid content method described in IDF bulletin 390 of march 2004 (6.6 for butter, 4.4 for cheese, 7,6 for skim/whole milk powder, 1.9 for skim condensed/evaporated milk, 2.1 for whole condensed/evaporated milk, 1.0 for yoghurt, 3.6 for cream, 7.4 for casein, 0.7 for skim milk, 1.0 for liquid milk and 7.6 for dry whey. Compound Annual growth Rate (CAGR)

Table 4 – Dairy consumption by region (kg of Milk equivalent per capita per year). IDF calculation based on FAO outlook June 2011 and June 2018, this apparent consumption calculation doesn't take into account regional stock variation.

Region	Cow milk production (million tonnes)			
	2010	2017	2010-2017 Absolute change	2010-2017 Percentage (CAGR)
Asia	164	212	48	3,7%
Europe	208	224	15	1,0%
EU	149	165	16	1,5%
Non-EU	59	58	-1	-0,2%
North America	96	108	12	1,7%
South America	61	65	5	1,0%
Africa	35	39	4	1,5%
Central America	16	18	2	1,3%
Oceania	27	31	4	2,2%

Table 5 – Cow milk production by region (million tonnes) (IDF, 2018)

Region	Average cow milk yield (tonnes/cow)			
	2010	2017	2010-2017 Absolute change	2010-2017 Percentage (CAGR)
Asia	1,6	1,9	0,3	2,1%
Europe	5,4	6,0	0,6	1,6%
EU	6,4	7,1	0,7	1,5%
Non-EU	3,9	4,2	0,3	1,2%
North America	9,5	10,4	0,91	1,3%
South America	1,9	2,3	0,40	3,1%
Africa	0,6	0,5	0,00	-0,2%
Central America	2,4	2,6	0,30	1,6%
Oceania	4,4	4,8	0,40	1,2%

Table 6 – Average cow milk yield by region (tonnes/cow) (IDF, 2018)

AUTHORS

Jan Maarten Vrij, Shawna Morris, Gilles Froment, Jurgen Janssen, Jennifer Huet, Melanie Richard, Veronique Pilet and Caroline Emond
The International Dairy Federation
cemond@fil-idf.org

ACKNOWLEDGEMENTS

The authors would like to thank IFCN for its contribution to this article.

REFERENCES

IDF (2013). The Economic Importance of Dairying. https://www.fil-idf.org/publication/economic-importance-of-dairying/. Accessed 13 December 2018.

FAO, GDP and IFCN. 2018. Dairy Development's Impact on Poverty Reduction. Chicago, Illinois, USA

IDF (2017). Bulletin 486/2017 Guide to Water Footprint methodology

IDF (2005). Bulletin 398/2005 Guide on Life Cycle Assessment towards sustainability in the Dairy chain

IDF (2018). The World Dairy Situation Report 2018

Population Reference Bureau (2018). https://www.prb.org/work-with-us/ Accessed 13 December 2018.

OECD and FAO (2018). OECD-FAO Agricultural Outlook, OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

Empowering the dairy sector through the Livestock Environmental Assessment and Performance (LEAP) Partnership

KEYWORDS:
LIVESTOCK, ENVIRONMENTAL ASSESSMENT, TECHNICAL GUIDELINES, LIFE CYCLE ASSESSMENT, RESOURCES

ALIGNMENT WITH SDGS:
THE MAJOR SDG'S ARE:

BACKGROUND

The dairy sector, together with the other livestock sectors is a major contributor to food security and provide livelihoods. The increase in demand for animal products, driven by growing populations and incomes is stronger than for most other food items. Global production of milk is projected to increase from 580 to 1043 million tonnes. The bulk of the growth in milk production will occur in developing countries. Yet the sector places pressure on many ecosystems and contributes to global environmental impacts (GHG, water, biodiversity etc.) The natural resource base within which production must be accommodated is finite, so the continuing expansion of the global livestock sector will, therefore, need to be accompanied by substantial efficiency gains.

The lack of broadly recognized frameworks, including both, metrics and methods for monitoring environmental performance is however a bottleneck to effective action.

Quantitative information on key environmental impacts along livestock supply chains is required to (a) analyze food systems and inform decisions at the production and processing levels to improve environmental performance, (b) develop and evaluate corresponding policy decisions (governmental and non-governmental), and (c) inform relevant stakeholders.

WHAT IS THE PARTNERSHIP AND HOW DOES IT WORK?

In July 2012, the LEAP Partnership was set up as a multi-stakeholder initiative that is committed to improving the environmental performance of livestock supply chains, whilst ensuring its economic and social viability. The LEAP Steering Committee is composed by 3 stakeholder groups, Governments, Private Sector, and Civil Society and Non-Governmental Organizations. The International Dairy Federation (IDF) represents the dairy sector within the cluster of Private Sectors. This Committee provides overall leadership, as well as approves the work programme of the Partnership. The Chair is rotated annually across the three groups in order to ensure equal footing in setting the agenda of the Partnership.

The Animal Production and Health Division of the Food and Agriculture Organization of the United Nations (FAO) hosts the LEAP Secretariat and ensures that the work of the LEAP Partnership is based on international best practices.

HOW DOES LEAP WORK?

Life-cycle thinking is a fundamental concept underpinning the work of the LEAP Partnership. This approach takes into account all of the inputs and outputs across life-cycle states.

Most of the LEAP technical activities are run by the Technical Advisory Groups (TAGs). These are special groups made up of experts from academia, the private sector, CSO and NGOs. They are formed to develop consensual guidance and methodology based on the latest scientific findings and existing recommendations. Once drafter, LEAP technical documents are then submitted for review by external peers and LEAP Secretariat. Stakeholder consensus is then sought through consultation with the LEAP Steering Committee. Once revised, LEAP technical recommendations are submitted for a 4-5-month public review.

WHAT HAS BEEN THE OUTCOME OF LEAP 1 AND LEAP 2?

LEAP 1 was largely focused on the harmonization of accounting rules for the quantification of GHG emissions from livestock supply chains (feed, small ruminants, large ruminants, poultry, pig). However, measurements of GHG emissions are partial metrics, and can lead to misleading conclusions if not placed within the proper context of the wider relationship between livestock and the environment. Environmental improvement measures solely selected on a single criterion (i.e. climate change) are likely to result in the shifting of burdens from one environmental impact category to another and poor policy choices. Thus, a biodiversity review and biodiversity guidelines were also released. The work on feed was extended to the creation of a global database of GHG emissions related to the five feed crops (barley, cassava, maize, soybeans and wheat)

LEAP 2 has been focused on the development of soil carbon stock changes guidelines, nutrient cycle guidelines, water foot printing guidelines, biodiversity guidelines and feed additives or change-oriented approached guidelines. Besides technical outputs, LEAP has also developed communication tools such as e.g. a brochure, public website and visual identity of the Partnership. All LEAP products are available on the LEAP website at http://www.fao.org/partnerships/leap/en/

SOME OF THE OUTPUTS OF LEAP 1 AND LEAP 2

relevant for the dairy sector are the following :

ENVIRONMENTAL PERFORMANCE OF ANIMAL FEEDS SUPPLY CHAINS: GUIDELINES FOR ASSESSMENT

Technical guidance document
Environmental assessment frameworks: LCA
Scope - Environmental accounting: GHG emissions, fossil energy use
Scope - Environmental impacts/resource use: Climate change, fossil resources depletion, acidification, eutrophication, land occupation

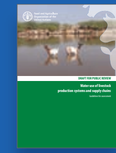
NUTRIENT FLOWS AND ASSOCIATED ENVIRONMENTAL IMPACTS IN LIVESTOCK SUPPLY CHAINS: GUIDELINES FOR ASSESSMENT

Technical guidance document
Environmental assessment frameworks: LCA, resource use efficiency, nitrogen footprinting, environmental footprinting
Scope: Crops and livestock
Scope - Production systems: All.

GREENHOUSE GAS EMISSIONS AND FOSSIL ENERGY USE FROM SMALL RUMINANT SUPPLY CHAINS: GUIDELINES FOR ASSESSMENT

Technical guidance document
Environmental assessment frameworks: LCA
Scope - Livestock species: Goats and sheep
Scope - Environmental accounting: GHG emissions, fossil energy use
Scope - Environmental impacts/Resource use: Climate change, fossil resources depletion

WATER USE OF LIVESTOCK PRODUCTION SYSTEM AND SUPPLY CHAINS: GUIDELINES FOR ASSESSMENT



Technical guidance document
Environmental assessment frameworks: water footprinting, LCA, resource use efficiency, water productivity
Scope: Crops and livestock
Scope - Production systems: All.

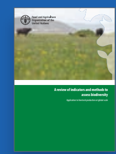
LEAP DATABASE ON FEED CROPS

Technical guidance document
Environmental assessment frameworks: LCA
Scope – Feed crops: Barley, cassava, maize, soybeans and wheat
Scope - Environmental accounting: GHG emissions

MEASURING AND MODELLING SOIL CARBON STOCKS AND STOCK CHANGES IN LIVESTOCK PRODUCTION SYSTEMS: GUIDELINES FOR ASSESSMENT

Technical guidance document
Environmental assessment frameworks: carbon footprinting, LCA, land management
Scope - Livestock species: mostly ruminants
Scope - Production systems: Guidance was developed for grasslands and rangelands; yet, it can also be used for any type of crop production.

A REVIEW OF INDICATORS AND METHODS TO ASSESS BIODIVERSITY – APPLICATION TO LIVESTOCK PRODUCTION AT GLOBAL SCALE

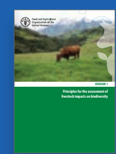


Technical guidance document
Environmental assessment frameworks: LCA, Pressure-State-Response (PSR)

ENVIRONMENTAL PERFORMANCE OF LARGE RUMINANT SUPPLY CHAINS: GUIDELINES FOR ASSESSMENT

Technical guidance document
Scope - Livestock species: Cattle and buffalo
Environmental assessment frameworks: LCA
Scope - Environmental accounting: GHG emissions, fossil energy use
Scope - Environmental impacts: Climate change, fossil resources depletion, water footprint, acidification, eutrophication, land occupation, biodiversity

PRINCIPLES FOR THE ASSESSMENT OF LIVESTOCK IMPACTS ON BIODIVERSITY



Technical guidance document
Environmental assessment frameworks: LCA, Pressure-State-Response (PSR)

BIODIVERSITY AND LIVESTOCK PRODUCTION SUPPLY CHAINS: GUIDELINES FOR QUANTITATIVE ASSESSMENT

Technical guidance document (under revision before external review)
Environmental assessment frameworks: LCA and PSR
Scope: Crops and livestock
Scope - Production systems: All.

ENVIRONMENTAL PERFORMANCE OF FEED ADDITIVE SUPPLY CHAINS: GUIDELINES FOR ASSESSMENT

Technical guidance document (under revision before external review)
Environmental assessment frameworks: LCA
Scope - Environmental accounting: GHG emissions, fossil energy use
Scope - Environmental impacts/resource use: Climate change, fossil resources depletion, acidification, eutrophication, water use, land occupation.

"Despite the range of environmental assessment methods that have been developed, there is a need for comparative and standardized indicators in order to switch focus of dialogue with stakeholders from methodological issues to improvement measures."

María Sánchez Mainar

FUTURE: LEAP3 PROJECT

LEAP work programme 2019-2021, is composed of 2 major components, namely

› **Road testing of LEAP guidelines:** This road-testing activity will be conducted in different countries and production systems to ensure that LEAP guidelines are applicable in different contexts:

- To ensure that the guidelines are easily applicable in all situations (geographical areas, production systems, assessment scales and objectives),
- To ensure consistency in recommendations across LEAP guidelines
- To identify any methodology gap hindering application
- To facilitate adoption by all LEAP partners and stakeholders
- To mainstream LEAP guidelines into projects and into existing environmental calculators
- To build awareness and enhance the use of LEAP guidelines in various application contexts.

› **Development, revision and dissemination of LEAP Guidelines:** LEAP guidelines developed in LEAP 1 and LEAP 2 may need to be updated based on the findings from road testing. In addition, current LEAP Guidelines have not covered all environmental dimensions. Some potential areas for additional consensus building and recommendation that have been identified are: ecosystem services, ecotoxicity, biomass carbon stocks and stock changes, and benefits from technology, feed ingredients and recovery of residues; guidelines on environmental tracking reporting. LEAP may also provide technical assistance to regional initiatives aiming at developing specific guidelines e.g. on climate-smart livestock production.

AUTHORS

María Sánchez Mainar
International Dairy Federation
msanchezmainar@fil-idf.org

REFERENCES

FAO (2018). Livestock Environmental Assessment and Performance Partnership http://www.fao.org/partnerships/leap/en/. Last accessed 13 December 2018

© CNIEL

Dairy Product Environmental Footprint: achievements, challenges, and opportunities

KEYWORDS:
DAIRY PRODUCT; LIFE CYCLE; ENVIRONMENTAL FOOTPRINT; SUSTAINABILITY; INPUT CATEGORY

ALIGNMENT WITH SDGS:
THE MAJOR SDG'S ARE:

9 · 12 · 13

BACKGROUND

The Dairy Product Environmental Footprint (PEF) pilot has been driven by the European Dairy Association (EDA) as a major project to understand better about the overall environmental impact of different dairy products in examining a broad array of environmental issues, like climate (GHG emissions) but also water use, land use change, allocation questions and others.

The framework of the Dairy Product Environmental Footprint pilot was laid out by the European Commission's DG Environment initiative "Building the Single Market for Green Products". In 2013, a pilot phase of three years was launched for non-food products, and in 2014 this was extended to 11 food and drink pilots. Namely, in May 2014, the EC approved the pilot to develop Product Environmental Footprint Category Rules (PEFCR) for the dairy sector. Through this initiative on the Single Market for Green Products, the European Commission aimed to harmonise the communication of environmental performances of products for producers and consumers alike. Member States and the private sector were encouraged to test a life cycle assessment (LCA)-based method developed by the European Commission's Joint Research Centre to measure the environmental performance of products throughout their life cycles.

Thus, EDA and several actors in the dairy and environmental sector joined forces to develop product category rules for the dairy sector to be used in Europe and beyond. They strived as much a possible to ensure that the wide diversity of dairy farming and dairy processing systems would be considered, in order to enable companies and organisations to assess, display and benchmark the environmental performance of products based on a comprehensive assessment of their environmental impacts over their full life cycle. This is especially important in the current context, where changes in dietary patterns and the concept of sustainable diets are gaining in importance in the drive towards reducing the food industries climate impacts. The participation of the dairy sector to the PEF project shows how the European dairy sector is continuously working on improving its unique circularity and sustainability and contributing to safeguard environmental resources, while providing healthy nutrition: dairy products, with all their natural nutrients, offer ultimately a resource and carbon efficient way of achieving a balanced diet.

The project started with assessing existing footprinting methodologies in the dairy sector, proceeded by defining the scope of five subcategories and the impact categories, for then elaborating detailed product environmental footprint category rules for the dairy sector. Testing studies on products have been done by the companies involved. Whereas the pilot does not cover directly communication tools, some were tested along the way. The Dairy Product Environmental Footprint pilot project was also reviewed twice by four reviewers from all around the world, including LCA experts, industry and NGOs, and finally received full support of the European Commission and Member States in the PEF Steering Committee on 19 April 2018. At the moment, the project is entering a legislative reflection phase, with the European Commission considering some form of transition to be implemented by 2020.

THE PEFCR IN A NUTSHELL

This PEFCR covers the full life cycle ("cradle to grave") for dairy products sold on the European and European Free Trade Association (EFTA) market. More specifically, it includes seven life cycle stages – (1) Raw milk, (2) Dairy processing,

(3) Non-dairy ingredients supply, (4) Packaging, (5) Distribution, (6) Use and (7) End-of-life – and provides detailed guidance related to the use of primary and secondary data, data quality requirements, allocation rules, impact categories that shall be addressed and further environmental information to be provided when assessing the PEF of dairy products.

The following subcategories are considered: liquid milk, dried whey products, cheeses, fermented milk products, and butterfat products. These subcategories were defined with the aim to make the complexity of the dairy sector understandable for all types of stakeholders: consumers, producers, retailers, food processors and regulators. Five different representative products – one for each of the product subcategories – are considered in this PEFCR. All representative products are virtual products, and characterise what is potentially sold on the European market, not what is produced within the European Union. This nuance may be significant for products that are more largely exported from, or imported to the EU. Specific non-dairy ingredients added to dairy products are a part of the product Environmental Footprint, but this PEFCR does not provide detailed guidance on them. For each of the subcategories included in the Dairy PEFCR, one screening study and at least one supporting study was conducted to test the applicability of the PEFCR on real products, identifying hotspots and the following relevant impact categories: climate change, water resource depletion, freshwater eutrophication, marine eutrophication, freshwater ecotoxicity land use, and acidification. As can be seen, the Dairy PEF methodology looks at several environmental indicators and not only at the carbon/climate one – this allows to give a much broader and more complete picture one the reality as well as highlight improvements done in the chain.

On this basis, a benchmark is calculated for each subcategory. Since no detailed market study on dairy products exists at the EU level, the benchmarks were assumed to be corresponding to the representative products defined in the screening study. While we do not question, as a matter of principle, the merits of a benchmark approach as a tool among others to enable final consumers to assess the Environmental Footprint of products placed on the market, we still identify several limitations. At the current stage of development of the PEF methodology, a mandatory and stringent benchmark approach would be premature, and its immediate implementation might give an inaccurate perception to consumers and a wrong incentive to the industry, at least for some of the subcategories.

RELATIONSHIP WITH IDF GUIDELINES

The Dairy PEFCR has been prepared in conformance with the International Dairy Federation (IDF) guide to standard life cycle assessment methodology for the dairy sector "A common carbon footprint approach for Dairy". However, the IDF Guide is not totally aligned with our PEFCR because it does not fully fulfil all mandatory requirements set by the European Commission (e.g. some stages are excluded from the product life cycle or some default impact categories are not included). While the IDF Guide solely focuses on carbon footprint, the Dairy PEFCR covers a wide range of environmental indicators and aims to reflect the diversity of dairy products in the EU.

NEXT STEPS

The success of the Dairy PEF pilot attests the European dairy sector's continuous effort for improving not only its economic performance, but also its long-term sustainability. In this perspective, the relevance of the Dairy PEF on the future of the dairy sector is confirmed by the discussions on the United Nations' Sustainable Development Goals (SDGs) and global effort of promoting more sustainable consumption and production. The global dairy sector has strengthened the necessary partnerships for achieving a sustainable dairy industry, and under the Global Dairy Agenda for Action it has come together to create the Dairy Sustainability Framework, which acts as a roadmap towards achieving greater sustainability and aligning such initiatives around the world.

Notwithstanding the significant results already achieved, the Dairy PEF methodology still leaves some room for improvement. Firstly, not all dairy products are covered by this PEFCR. In addition, the default data provided have limited applicability to products or materials imported from outside the EU. Uncertainty also remains on the economic allocation for the slaughterhouse part. Another limitation is that LCA impact categories do not cover all impacts of dairy systems on biodiversity, while livestock production plays an important role on biodiversity. Our approach on biodiversity will hopefully be further improved in the future when international scientific consensus is reached on the topic. Last but not least, there is still a level of uncertainty regarding the future governance of the PEFCRs. The future policy options at EU level are unclear, possibly including the integration of the methodology into the EU Ecolabel and Green Public Procurement, or even the creation of a new instrument on green claims.

With regard to the possibilities on communication to consumers, the current Dairy PEFCR may only support comparative assertions among dairy products from the same subcategory. At this stage, it is in the first place an internal tool for companies for monitoring the environmental improvements over time and managing impacts associated with the products concerned. It is not meant for comparing dairy products from different subcategories or comparing dairy and non-dairy products, also because relevant aspects of concern, e.g. regarding health, quality, and nutritional value are not included in its scope.

Nevertheless, the approved Dairy PEF is already a major step in shaping the future of the dairy industry and showing responsibility in working on a wide array of environmental tropics, including biodiversity and deforestation. It is now the reference methodology, and brings the dairy industry and its partners to a new milestone on the proactive approach to positioning dairy as a healthy and sustainable food category.

AUTHORS
Alexander Anton[1],
Hélène Simonin-Rosenheimer[2]
European Dairy Association
[1]aanton@euromilk.org
[2]hsimonin@euromilk.org

© Danish Dairy Board

RESEARCH

Ammonia volatilisation following surface application of dairy slurry and urea on permanent on grasslands of Southern Chile

KEYWORDS:
AMMONIA LOSSES, GASES EMISSIONS, NITROGEN, DAIRY SLURRY, UREA

ALIGNMENT WITH SDGS:
THE MAJOR SDG´S ARE:

BACKGROUND

Ammonia (NH3) is an important air pollutant largely emitted from agriculture. The gas is generated, among other sources, from livestock, mainly dairy and beef production systems, especially when dairy slurry or fertilizers are applied to land. There are only few studies published on NH3 volatilisation in Latin American countries, which information is a key tool for national NH3 inventories and mitigation options to be implemented (Lagos et al., 2010). In addition, NH3 is one of the most important pathways of nitrogen losses on dairy production systems, therefore mismanagement of this gas could reduce the nitrogen use efficiency and cause pollution to the wider environment.

The NH3 followed transformation, transport and deposition, can caused a wide range of environmental impacts such as soil acidification, eutrophication of aquatic systems, acid rain, disturbance of the nutrient balance in trees, loss of diversity, odours and impacts on human health (Asman et al., 1998; Sommer and Hutchings, 2001). Therefore, a reduction target in the NH3 emission has been set in European countries under the Convention on Long-Range Transboundary Air Pollution of the United Nations.

OBJECTIVE

The objective of this research has been to evaluate NH3 volatilisation losses following surface application of dairy slurry or urea to permanent pastures on volcanic soils of southern Chile. A set of experiments were carried out on small plots, using wind tunnels (Lockyer, 1984) technique to measure NH3 losses under field conditions (Figure 1).

> "This study showed that there was a large effect of the N source on the NH3 emissions. Total NH3-N losses were higher after urea fertiliser application compared with dairy slurry"
>
> **Francisco Salazar**

RESULTS

There was a large effect of the N source on the NH3 emissions. Total NH3-N losses were higher after urea fertiliser application compared with dairy slurry. During spring trial total N losses were 25.3 and 9.4 Kg N ha-1, which is equivalent to 25% and 22% of the total N applied for the urea and the dairy slurry treatment. During the autumn trials the total N losses ranging from c. 20 to 30 kg N ha-1 (c. 20 to 30 % of total N applied) and c. 6 to 8 kg N ha-1 (c. 7 to 9 % of the total N applied) for the urea and the dairy slurry treatment, respectively. In order to critically compare the different treatments, comparisons should be made of the proportion of TAN applied (N-NH4

Figure 1 – Small wind tunnel technique used to evaluate ammonia losses following dairy slurry and urea application to permanent grasslands.

loss/N-NH4 applied x 100). Based on this parameter, results from the present study showed that emissions were higher for dairy slurry (22% to 55%) compare to urea (20 to 30%). These values are in the range of studies carried out elsewhere (e.g. Huijsmans and Schils, 2009).

The highest peaks of NH3 emission were obtained on dairy slurry treated plots, occurring within the first six hours after manure application, declining progressively in the successive hours and becoming low after the first 24 hours after application. This resulted, for all the experiments, in a high proportion of the NH3-N being lost within the first 24 hours, which was equivalent to c. 53-67% of the total N loss of the experimental period in the dairy slurry treatment. For urea there were peaks during the measuring period, which were lower than the one observed with slurry. Between 49-59% of the total N loss of the experimental period was volatilised by 96 h of evaluation, which were probably associated with the transformation process of this fertiliser in the soil.

Results showed that ammonia emissions from slurry and urea can be one of the most important pathways of nitrogen loss when applied to acid volcanic soils of southern Chile (Salazar et al., 2012, 2114). The volatilization of NH3 could affect the efficiency of the N fertilizer affecting the forage dry matter production in pastures and increasing the management costs for the farmers. Therefore, good management practices on these swards should target the reduction of losses through volatilisation. Low emission slurry application equipment is now available (e.g. Misselbrook et al., 2002) but, it is necessary to increase the adoption of these 'environmentally friendly' technologies by farmers. In addition, it is important to consider that the use of this equipment could represent an increase in the application costs for farmers. Incorporation of Best Management Practices (e.g. more efficient equipment) could reduce N losses due to NH3 volatilisation and increase dry matter yields, which will have benefits from economic and environmental point of view.

ACKNOWLEDGMENTS

This research was funded by the Scientific and Technological Research Council (FONDECYT), projects 1080368 and 1151078.

AUTHORS

Francisco Salazar S.[1], Marta Alfaro V.[1], Josué Lagos M.[1], Tom Misselbrook[2]
[1] Instituto de Investigaciones Agropecuarias, Centro Regional de Investigación INIA-Remehue, Chile; [2] Rothamsted Research, Devon, UK.
fsalazar@inia.cl

REFERENCES

FAO (2018). Livestock Environmental Asman, W., M. Sutton, and J. Schjorring. (1998). Ammonia: Emission atmospheric transport and deposition. New Phytol, 139, 27-48.

Huijsmans, J. and Schils, R. (2009). Ammonia and nitrous oxide emissions following field-application of manure: state of the art measurement in the Netherlands. International Fertiliser Society Proceedings Nº 655 (United Kingdom). 37p.

Lockyer, D. (1984). A system for the measurement in the field of losses of ammonia through volatilization. J. Sci. Food Agric., 35(8), 837-848.

Lagos, J., Salazar, F., Alfaro, M., Misselbrook, T. (2010). Inventory of ammonia emissions from the livestock production in Los Lagos and Los Rios Regions, Chile. Chilean Journal of Agricultural Research, 70, 95-103

Misselbrook, T., Smith, K., Johnson, R. and Pain, B. (2002). Slurry application techniques to reduce ammonia emissions: Results of some UK field-scale experiments. Biosystems Engineering, 81, 313-321.

Salazar, F., Martínez-Lagos, J., Alfaro, M. and Misselbrook, T. (2012). Ammonia emissions from urea application to permanent pasture on a volcanic soil. Atmospheric Environment, 61: 395-399

Salazar, F., Martínez-Lagos, J., Alfaro, M. and Misselbrook, T. (2014). Ammonia emission from a permanent grassland on volcanic soil after the treatment with dairy slurry and urea. Atmospheric Environment, 95: 591-597

Sommer, S. and N. Hutchings. (2001). Ammonia emissions from field applied manure and its reduction. Eur. J. Agron., 15, 1-15.

Co-composting of residual fats from the dairy industry separated by a dissolved air flotation equipment (DAF)

KEYWORDS:
DAIRY INDUSTRY, WASTEWATER, DISSOLVED AIR FLOTATION EQUIPMENT, BIOSOLIDS, COMPOST

ALIGNMENT WITH SDGS:
THE MAJOR SDG´S ARE:

INTRODUCTION

The dairy chain is one of the most important and dynamic agri-food complexes in the Argentine economy, for many years, this type of industry has experienced a remarkable growth, which involved a greater generation of liquid effluents and biosolids. The industrialization of the milk originates different products, because of that; the characteristics of the contamination vary considerably (Carvalho et al., 2013).

The most important environmental problem in the dairy industry is the generation of wastewater, both because of its volume and the associated pollutant load, mainly of organic nature. If these effluents are not treated properly, they cause problems of contamination in soils or natural water in which are discharged.

Dairy wastewater is characterized by high biological oxygen demand (BOD) and chemical oxygen demand (COD) concentrations, and generally it contains fats, nutrients, lactose, as well as detergents and sanitizing agents.

Due to dairy wastewater are highly biodegradable, it can be effectively treated by biological processes that combine anaerobic, aerobic and facultative reactions. Independently of the type of effluent treatment system carried out, the presence of FOGs (fat, oil, grease) in the effluents can cause different kinds of problems in the biological treatment systems, therefore it is essential to reduce or eliminate completely these components before to any treatment (Britz and Mostert, 1977).

Common techniques for treating dairy industry wastewaters include grease traps, oil water separators, equalization of flow, and clarifiers to remove solids. Over the last ten years, there has been an increasing interest on the use of Dissolved Air Flotation equipments (DAF) for clarifying solids from biological systems. DAF is a relatively simple technology that uses fine air bubbles to separate liquid particles and light suspended solids (mostly fats) from wastewater. These particles and solids are floated via the

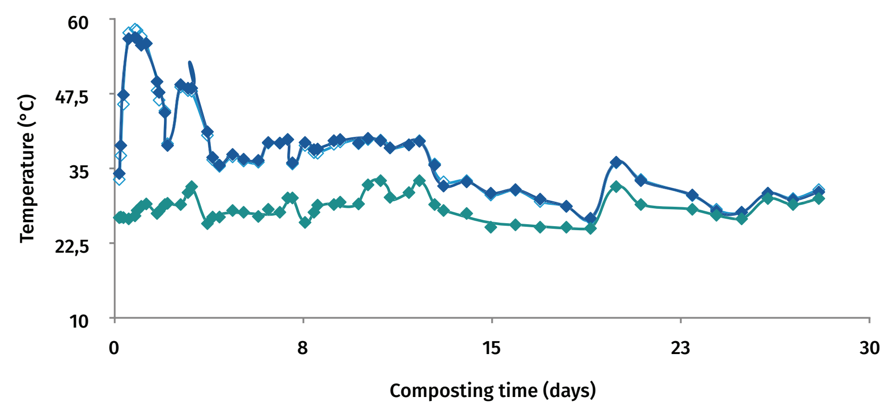


Figure 1 – Variation of temperature in 20 % addition of DAFw mixtures (blue) during the thermal activity period compared to room temperature (black)

Figure 1 – Reactors with the compostable mixtures in the pilot plant

bubbles to the surface of a flotation cell for removal from a wastewater stream.

The management of these biosolids (DAFw) is complicated, this type of waste has similar properties that sludge from grease traps and was expected to be suitable for biological treatment in anaerobic reactors or aerobic composting using several co substrates as bulking agents and C-N sources (i.e., wood shavings and chips, green grass among others).

Most of the times, the proper disposal of these biosolids generates high costs, so it is essential to find options that are reliable, legally acceptable, economically viable and easy to implement. Thus, there is a need to search for biosolids transformation systems, optimizing their reuse through the exploitation of their components, allowing them to reintegrate into the soil and therefore to the biogeoecological cycles.

Many research groups have investigated the limitations of anaerobic fat treatment, focusing mainly on the inhibitory action of long-chain fatty acids on methanogenic bacteria (Davidsson et al. 2008). Meanwhile, several groups of researchers studied with favourable results the co-composting of residues of a lipid nature (Ruggieri et al. 2008), which leads us to suppose that this residue from the DAF would be efficiently treated in co-composting processes.

In this sense, the aerobic processes of degradation, such is the case of composting would be more effective for the treatment of residual fats. Composting involve the decomposition and biological stabilization of organic substrates. Composting is a microbiological process in which different microbial communities initially degrade organic matter into simpler nutrients and, in a second stage, complex organic macromolecules such as humic acids are formed (Hsu and Lo, 1999). It is an aerobic process, which requires oxygen to achieve optimal microbial biodegradation, moisture and porosity. It is a transformation process by which, under controlled operating conditions, the organic matter contained in the waste is biologically degraded in an aerobic form generating gases (CO_2 and NH_3) and a stabilized solid (compost) that it admits multiple uses and depending on its quality, it can be used as a soil fertilizer (Cayuela et al. 2009).

The main objective of this work was to study the viability of the composting of DAFw with different co substrates and determine the effect of different proportions of DAFw on composting efficiency and final compost quality.

“The dissolved air flotation waste is feasible to use in aerobic co-digestion processes improving the environmental management and sustainability in the dairy industry”

Erica Schmidt

MATERIALS AND METHOD

Different amount of DAFw (70, 60, 50, 30, 0 % w/w) from a local dairy industry were added to a mixture of wood chips and green grass as bulking agent and C/N source. The composting process was performed in open air windrows (100 L ca.) with periodical turnovers. The physical - chemical characterization of the residues were carried out following standardized protocols.

Based on the characterization carried out, the reactors were assembled, for which the appropriate combination of the RSO was formulated in order to obtain an initial substrate of the desired characteristics depending on the variable to be studied.

In order to evaluate the process many laboratory analyses were carried out, its included moisture, temperature, particle size, electrical conductivity, pH, Nitrogen (Kjeldahl), ash, organic matter and grease. Furthermore, phytotoxicity of the compost was studied using germination test (relative seed germination, RSG).

PRELIMINARY RESULTS

The evolution of the temperature has been carefully considered. When DAF waste was added to the mixture the temperature reached the thermophilic range in comparison with a blank mixture without DAFw (Figure 1). It is possible to conclude the feasibility of the DAFW valuation using composting process and the improvement of quality of the obtained final product. Tables 1 and 2 show the characteristic the results of the characterization of the waste used

Substrate	Moisture (%, w.w)	pH	Volatil Solid (g/100 g d.w)	Total solid (g/100 g)	EESS (g/kg)	Tot.N (%, d. w.)
DAF Waste	85.95	5.91	83.40	14.05	41.81	2.21

Table 1 – Characteristics of DAF waste [wet weight (w.w); dry weight (d.w.); biosolid waste (DAFw)]

Substrate	Moisture (%, w.w)	pH	Ass (%, d. w.)	Org C (%, d. w.)	Org.N (%, d. w.)	C/N relation
Wood chip	9,7	6,9	6,0	52,2	0,09	580,0
Green Grass	70,5	7,7	14,8	47,3	3,6	13,1

Table 2 – Characteristics of wood chip and green grass [wet weight (w.w); dry weight (d.w.); biosolid waste (DAFw)]

CONCLUSIONS

From the analysis parameters of various set of experiences, the best results in terms of process efficiency has been obtained in reactors containing from 40 to 60% DAFw, these results allow us to affirm the hypothesis that this residual biosolid from the dairy industry can be valorised through composting processes in co-digestion with other organic waste.

Regardless of the conditions studied, 100% of the reactors to which DAFw have been added have shown better efficiencies in terms of thermal behaviour. These being significant within 24 to 72 hours of the beginning of the process.

According with these results, DAFw has been used as a co-substrate in mixture with other organic residues that present lower energy content, DAFw would help to reach the temperature ranges for sanitization of the compost since it is considered that the death of pathogens occurs with a temperature of 55 ° C for at least 72 hours.

The percentage of DAF waste used directly affects the quality of the final product. A final product with good physical and chemical quality has obtained, resulting in beneficial effects for plant physiology.

Based on the results obtained it was possible to observe that the dissolved air flotation waste is feasible to use in aerobic co-digestion processes improving the environmental management and sustainability in the dairy industry.

AUTHORS

Carlos Martin[1], Erica Schmidt[2]

[1] Instituto de Desarrollo Tecnológico para la Industria Química (INTEC), Universidad Nacional del Litoral y CONICET, Santa Fe, Argentina; [2] INTI Lácteos, Rafaela, Santa Fe, Argentina.

eschmidt@inti.gob.ar

REFERENCES

Britz, T., Mostert, J. (1977). Two – phase anaerobic digestion of three different dairy effluents using a hybrid bioreactor. Water S.A, 23, 151 – 156.

Carvalho F., Prazeres A & Rivas J. (2013). Cheese whey wastewater: Characterization and treatment. Sci.Total Environ. 445–446 385–396.

Cayuela M.L.; Mondini C.; Insam H.; Sinicco T. y Franke-Whittle I. Plant and animal waste composting: effects of the N source on process performance. Bioresoruce Technol. 100 (2009) 3097-3106.

Davidsson C., Lo̎vstedt J., la Cour Jansen C. (2008). Co-digestion of grease trap sludge and sewage sludge. WM&R 28 986–992.

Hsu, J., Lo, S. Chemical and spectroscopic analysis of organic matter transformations during composting of pig manure. (1999). Environ Sci Pollut R104, 189–196.

Ruggieri, L., Artola A., Gea T. (2008). Biodegradation of animal fats in a co-composting process with wastewater sludge. Biotechnol. Bioeng. 62 297–303.

c Dairy Farmers of Canada

Summer supplementation of dairy cows with Turnip and Rape: Effects on milk and cheese fatty acid profile

KEYWORDS:
BRASSICA, MILK PRODUCTION, LONG-CHAIN FATTY ACIDS, POLYUNSATURATED FATTY ACIDS.

ALIGNMENT WITH SDGS:
THE MAJOR SDG´S ARE:
3, 9, 12

BACKGROUND

In Chile, the relative importance of grazing systems has increased steadily over time. One characteristic of pastures in the south of Chile is that there is a relatively high pasture growth during spring and autumn; and low growth, and thus pasture availability, during winter and summer. Considering that most calving's in dairy farms of southern Chile occur in fall (March, April and May) and spring (August, September and October), a low pasture availability during early and mid-lactation usually occurs, and it is common to observe an overgrazing and pasture degradation. In addition to the affected-on growth rate of the permanent prairies in summer season, the nutritive quality of pastures also decreases. Thus, concentrate supplementation is a typical measure in dairy farms during winter and summer although it is not always profitable due to the increasing costs of concentrate. It has been suggested that growing crops on-farm helps to reduce the need for purchased supplements and, therefore reduces production costs and increases profitability. However, the use of supplementary crops in Chilean grazing dairy systems is still low representing less than 5% of the mean annual diet.

Summer Brassica crops might be a complement to pastures due to their high dry matter yield and relatively high nutritive value. Turnip and rape are crops of the genus Brassica used to supply feed demand in the summer. In the literature, milk production of cows supplemented with Brassicas has had a variable response. In addition, there are few studies describing the fatty acid profiles contained in milk and derived products. Therefore, the objective of this study was to evaluate the effect of summer supplementation with turnip (Brassica rapa spp. rapa L.) and rape (Brassica napus spp. biennis L.) in dairy cows on the DMI, production and milk composition, and fatty acids profile of milk and cheese.

MATERIALS AND METHODS

The investigation was carried out in the Experimental Agricultural Austral Station

(EEAA) of the Austral University of Chile. The animals were selected according to milk production in the previous lactation. Twelve multiparous lactating dairy cows (25 kg/day of milk production, 90 DIM) were randomly allocated to the three dietary treatments according to milk production measured during the uniformity period, in a replicated 3 x 3 Latin Square design with three 28-day periods. Each experimental period consisted of 14 d of adaptation to diets and 7 d of experimental measurements. Cows were held in individual tie stalls. The first group (control) was offered a diet similar in type and quantity of feed offered to cows in dryland farms (16 kg DM: 6 kg DM of pasture, and 6 kg DM pasture silage and 4 kg DM of concentrate). The same levels of feed were offered to the other two groups, but in addition 6 kg DM of either turnip or rape was offered, thus substitution of brassica supplementation was determined. A 200 g mineral mixture was offered along with the silage. Prior feeding, all feeds were weighed and offered individually for each cow according to the dietary treatments.

During the 7 days of measurement milk production and dry matter intake (DMI) were recorded, and samples diet of ingredient were taken and analyzed for DM, crude protein, metabolizable energy and NDF. Additionally, blood and milk samples were taken for fatty acid analysis by gas chromatography. At the last day of each period 15 L of milk were obtain from each treatment for cheese production.

RESULTS AND CONCLUSIONS

Dry matter intake (DMI) and production are shown in table 1. The DMI was lower in treatment were brassicas were included (1 kg lower, approximately), with no differences in milk production or composition but, cows supplemented with turnip and rape were more efficient, that mean, this cows' production was similar with less DMI.

Fatty acid profile of milk and cheese are presented in table 2. In general terms, the results indicate that the supplementation with turnip and rape, substantially modified the profile of fatty acids (AG) contained in the blood plasma and in the milk, increasing the saturated fraction and decreasing the content mono and polyunsaturated, when comparing the results with the control treatment. The organoleptic characteristics of the cheeses made from the milk of cows supplemented with turnip and rape, showed a greater intensity in the flavour, aroma, itch and bitterness.

Our study shows that turnip and rape could be an interesting alternative to concentrate for summer supplementation with no negative effects on milk production but with a lower DMI, and decreasing the cost of milk production, since lest concentrate and lower DMI is needed.

AUTHORS

Christian Alvarado[1], *,
Juan Pablo Keim[1], Guillermo Seguel[1],
Einar Vargas-Bello-Pérez[2]
[1] Instituto de Producción Animal, Facultad de Ciencias Agrarias, Universidad Austral de Chile, Valdivia, Chile. [2] Departamento de Ciencias Animales, Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile, Santiago, Chile.
✉ calvarado@uach.cl

ACKNOWLEDGEMENTS

This work was supported by the Chilean National Fund for Science and Technology (FONDECYT) number 11150538 "Optimising milk production of pasture-fed lactating dairy cows through the utilization of winter and summer brassicas"

Item	Treatment		
	Control	Turnip	Rape
DMI (KG)	19,00	17,88	18,02
Uncorrected milk production (L)	24,16	24,11	24,31
4% fat corrected milk (L)	25,19	25,17	25,76
Energy corrected milk (L)	26,78	26,96	27,37
Efficiency (/CMS)	1,27	1,35	1,35
Milk composition (%)			
Lactose	4,87	4,84	4,88
Fat content	4,28	4,28	4,41
Protein	3,31	3,42	3,36

Table 1 – Dry matter intake (DMI) and milk production

Item	Treatment		
	Control	Turnip	Rape
Milk			
Σ SFA	72,45	75,99	77,13
Σ MUFA	25,53	22,60	21,42
Σ PUFA	2,01	1,41	1,45
Σ n-3 FA	0,47	0,21	0,16
Σ n-6 FA	0,81	0,73	0,8
Cheese			
Σ SFA	73,99	76,32	77,88
Σ MUFA	24,28	21,93	20,73
Σ PUFA	1,73	1,75	1,39
Σ n-3 FA	0,40	0,36	0,21
Σ n-6 FA	0,90	0,98	0,73

Table 2 – Fatty acid profile of milk and cheese.

Ready-To-Eat Dairy-based Meal

KEYWORDS:
BRASSICA, MILK PRODUCTION, LONG-CHAIN FATTY ACIDS, POLYUNSATURATED FATTY ACIDS.

ALIGNMENT WITH SDGS:
THE MAJOR SDG'S ARE:

BACKGROUND

Ready-to-eat foods (RTE), also called convenience foods, are commercial preparations designed for ease of consumption and convenience. Urban lifestyles, increasing distances between home and the workplace, women at work, and changes in family cohesion are all factors increasing the demand for processed, RTE food. This has resulted in a very active food processing industry in the business of manufacturing RTE foods. According to some report published the global RTE food market is expected to grow at a 21.8% Compound Annual Growth Rate (CAGR) during the forecast period 2018-2023 (Mordor Intelligence, 2017).

Yet, the RTE foods currently available in the market are not considered to be healthy choices. Keeping view of people's desire for a healthy, nutritious, palatable and independently consumable RTE food, NDDB took up the work of developing an RTE meal which can overcome the disadvantages of the currently available fast foods in the market.

THE PROCESS

During the product development phase, several concepts were tried upon, like dry premix for corn flakes, layered food containing dairy and non-dairy ingredients, cake-like cereal-dairy combination products etc. After working on many such concepts and giving due consideration to consumer preferences for taste and health, the concept of mixing and processing together the milk derived protein, cereals, pulses, vegetables and spices was finalized. A product was prepared which was based on the finalized concept. The product achieved a high sensory score during organization level sensory evaluation. The product processing was designed in a way that minimum loss is occurred to the nutrients present in the raw materials used in the product. Also, it is a known fact that protein from vegetable and animal sources (milk in this invention), has supplementary effect when consumed together as these provide different sets of essential amino acids.

Following objectives were taken into consideration while developing the present form of invention:

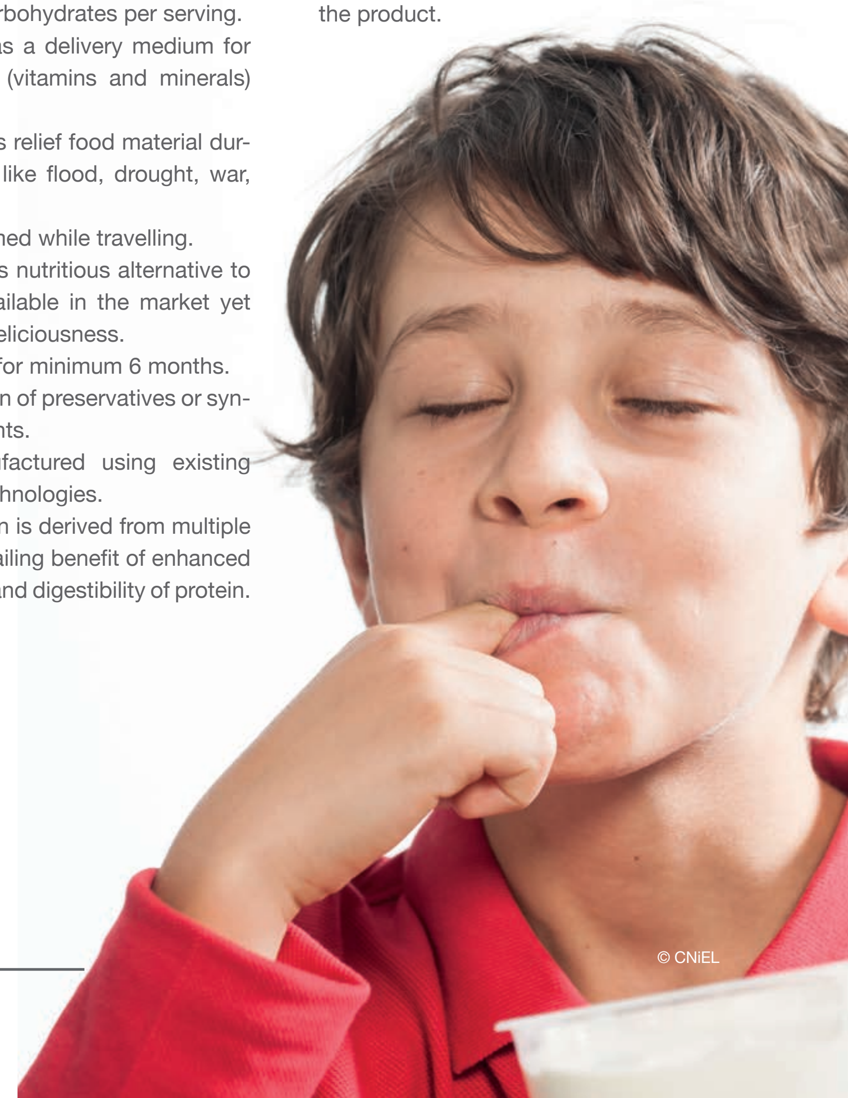
To prepare an RTE meal containing the essential macronutrients in a proportion close to that required by the human body that:

- capable of providing minimum 25 per-cent of human daily requirement of fat, protein and carbohydrates per serving.
- can be used as a delivery medium for micronutrients (vitamins and minerals) in humans.
- can be used as relief food material dur-ing calamities like flood, drought, war, famine, etc.
- can be consumed while travelling.
- can be used as nutritious alternative to junk foods available in the market yet retaining the deliciousness.
- can be stored for minimum 6 months.
- without addition of preservatives or syn-thetic ingredients.
- can be manufactured using existing processing technologies.
- in which protein is derived from multiple sources for availing benefit of enhanced bioavailability and digestibility of protein.

A process was standardized for com-mercial manufacturing of the product which involves following steps:

1. **Preparation of cottage cheese** (*chhana/paneer*): It may be prepared either by using traditional Indian methodology or by any other process which may involve manual processing, mechanization/semi-mechanization, enzyme treatment, membrane processing technology and similar processes, either singly or in combinations. The traditional process involves following steps:

a) **Standardization and pre-treatment of milk:** Milk is standardized to preferably but not limited to 4.5% fat and 8.5% SNF. Milk derived cream and skimmed milk powder/whole milk powder might be used for the purpose of standardization. The standardized milk is then heated to 85°C to 95°C and held at this temperature for 10 min. However, any other suitable time-temperature combination might be used for the purpose of whey protein denaturation and to ensure microbiological safety of the product.



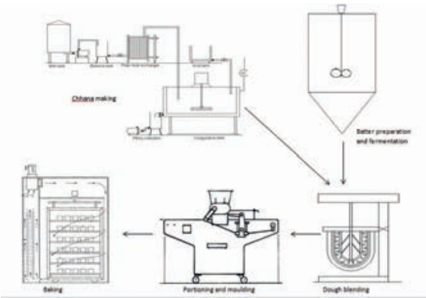


Figure 1 – Process layout for manufacturing dairy-based RTE meal

"In India we have developed a ready-to-eat Dairy-based meal that provides nutrition while retaining the deliciousness"

Harendra Pratap Singh

b) **Coagulation:** The heat-treated milk is brought to 70-90°C and coagulated at this temperature using freshly prepared 1-2% citric/lactic acid solution (actual citric /lactic acid requirement is approximately 0.2% of the milk) or any other permitted coagulant. The coagulant is slowly and continuously added to the milk till the milk gets coagulated and pH of whey reaches 5.0 - 5.5. The coagulated milk is then kept undisturbed for 5-10 minutes.

c) **Draining of whey:** When coagulation is complete the curd is allowed to settle down, the whey is drained out and the coagulum is wrapped into sanitized muslin cloth. The muslin cloth containing the coagulum is then hung onto a hook for 10-15 minutes for further draining whey, and then placed into the potable chilled water till further processing.

2. **Preparation of cereal-pulse batter:** Coarsely ground rice/wheat/corn flour, pigeon pea flour, chickpea flour and black gram flour are mixed in the ratio of 50:25:12.5:12.5 respectively or any other suitable combination. Moong dal flour and other lentils/cereals may also be added. Equal quantities of whey/ water and flour are mixed together and kept for 4-6 hours for soaking. Alternatively, ingredients (rice/wheat/ corn, split pigeon pea, chick pea, and black gram) may be soaked overnight in potable water and then ground to make a paste. Fermentation of the batter may be done for flavour enhancement and increasing the digestibility of the product. If fermented batter is made, then a suitable culture (bacteria or yeast based or mixed) may be added to the batter. The batter is then incubated at 30 to 40°C for 4-8 hours and then transferred to refrigeration (below 10°C) till further processing. Fermentation without external culture addition is also possible due to presence of indigenous micro-organisms in batter.

3. **Preparation of dough:** The soaked cereal-pulse batter and chhana/paneer are put together in a planetary mixer. Required quantities of grated bottle gourd or cucumber or carrot, green chilli paste, garlic paste, ginger paste, salt, sugar, turmeric, baking powder, citric/ lactic acid are also added to the mixture in a suitable combination as preferred. Other spices/condiments/herbs/fruit pulp/fruit chunks/vegetables etc. may also be added at this stage. The mixture in blended in the planetary mixer till a smooth pasty texture is achieved.

4. **Moulding:** The prepared dough is distributed in suitable sized food grade non-stick coated moulds made of stainless steel or aluminium or silicone. If non-stick coated moulds are not available then baking paper or banana leaf lining may be done in the inner surface of the mould. Moulding may not be required for shapes like cookies or biscuits. Moulding process may either be manual or automated.

5. **Baking and cooling:** The moulded product is placed inside a time-temperature controlled bakery oven pre-maintained at 200-250°C. Alternatively, continuous baking tunnels may be used. The product is baked till desired level of browning is achieved on the outer surface of the product. This normally takes 20-40 minutes in an industrial oven. The baking imparts a typical aroma to the product. After baking, the product is allowed to cool to room temperature. For rapid cooling, dehumidified forced air circulation may be used.

6. **Application of toppings:** Topping may or may not be done. Topping ingredient may include vegetarian (as per the Indian food law) ingredients such as cheeses, capsicum, tomato, oregano, chilli flakes, paneer, etc. or non-vegetarian ingredients such as boneless chicken, mutton, pepperoni, etc. Toppings may consist of single ingredient or combination of ingredients. Toppings may vary based on preferences.

7. **Packaging:**

a) **For product with topping:** The individual units of the product may be packed in any suitable food grade packaging material. Microwavable/oven safe containers may also be used for product packaging as this will eliminate the requirement of shifting the product to another vessel for thawing and consumption.

b) **For product without topping (base only):** Either individual units may be packed in a suitable packaging material or multiple units may be stacked together in a single pack, duly separated from each other with appropriate partitions between the units so as to prevent sticking of the units with each other during freezing process.

8. **Storage:** The product may be frozen to achieve longer shelf-life. For frozen storage, the product is generally stored below -18^{0}C. Freezing tunnels may also be used. For shelf-life of 7-10 days, the product may be stored under refrigeration (8^{0}C or below). At ambient temperature, the product may be stored for 2-3 days when properly packed in polythene or PP cup.

9. **Thawing for consumption:** The frozen product is required to be thawed before consumption. Thawing may be done in microwave oven or in steaming vessel. For thawing in microwave oven, the product container may be microwaved at "defrost" setting for 2-3 minutes, then kept as such for 2 minutes for even distribution of heat in the product and then again microwaved (microwave + convection mode) for 1-2 minutes. Alternatively, the frozen product may be transferred from the freezing chamber of the refrigerator to the cooling chamber for 24 hours for de-freezing and then heated for suitable time in microwave oven, OTG, steamer or tawa before consumption.

KEY OUTCOME

A healthy and nutritious product, the "RTE Dairy-based Meal" was obtained as an outcome. This product is a unique combination of cottage cheese (chhana/ paneer), cereals, pulses, vegetables and spices which makes this product a standalone source of protein, carbohydrate, fat and dietary fiber together. The product can provide 25% or more of daily requirement of fat, protein and carbohydrates per serving along with the benefit of enhanced bioavailability and digestibility of protein. The product can be consumed as such or after heating it in a microwave oven or steamer. The product can be stored frozen, refrigerated or at room-temperature.

Nutrients are provided in a healthier proportion and can be adjusted as per nutritional requirement of the target population. Synthetic ingredient and preservatives are not part of the recipe. It is a vegetarian meal (as per the India food law) in which protein has been derived from milk and pulses. As a known fact, the protein derived from multiple sources is more nutritious in terms of amino acid profile and bioavailability. Toppings may be of vegetarian or no-vegetarian type depending upon consumer preference.

RELEVANCE OF THE TOPIC ON THE FUTURE OF THE DAIRY SECTOR

The product is aimed at providing nutrition while retaining the deliciousness. The results of sensory evaluation have indicated high acceptance of the product among the general population.

The product may prove very useful for bachelors, working couples, frequent travellers, early morning office goers, etc. Apart from that, this meal also has potential to be used as relief food material during calamities like flood, drought, war, famine, etc. or may be used as comprehensive food package for security forces deputed at remote border locations where availability of fresh food is an issue and the temperatures allow prolonged storage of food without the need for refrigerators etc.

AUTHORS

Harendra Pratap Singh*, Vishal Trivedi, Lalita Oraon, Ketan Dave, Aditya Jain, D K Sharma

Product and Process development, NDDB, Anand, Gujarat, India - 388001

*hpsingh@nddb.coop

REFERENCES

Mordor Intelligence (2017) Ready to Eat Food Market Size, Analysis – Growth, Trends, and Forecasts (2018- 2023) https://www.mordorintelligence.com/industry-reports/ready-to-eat-food-market. Last accessed 16 December 2018.

Dahi-based Spread

KEYWORDS:
DAHI, FERMENTATION, HEALTH, PROTEIN, SPREAD.

ALIGNMENT WITH SDGS:
THE MAJOR SDG´S ARE:

BACKGROUND

In last few years, people have become more health conscious which encourages them to daily exercise, meditation/yoga, eat healthy and nutritious food. Now-a-days people choose those foods which promote their welfare and reduce the risk of diseases. In addition to this, change in life style, increase in the number of working women, eating habits and time shortage calls for food which is healthier and also convenient to use.

Dahi-based spread incorporates benefits of fermentation and spread ability and is a combination of higher protein and/or lower fat than the conventional spreadable products. It is also convenient to use and can be eaten with a variety of foodstuffs.

THE PROCESS

During the product development phase several recipes and process parameters were tried. First step was to select culture which leads to minimum or no whey separation after fermentation. Generally, preparation of concentrated curd requires whey draining after fermentation. However, in case of this *dahi* spread, the process has been so standardized that whey draining is not required. After that the challenge was to increase the viscosity of the product to a desired level. Also, several ways to increase the shelf-life of the product were tried.

Finally, a multi-step process was standardized for commercial manufacturing of the product which is as follows:

a. **Milk Standardization:** Milk is standardized to 8.5% fat and 18% SNF. Milk derived cream and skimmed milk powder were used for the purpose of standardization. The cream is added when temperature of milk reaches about 400C and skimmed milk powder is added when temperature reaches to around 550C for better reconstitution.

b. **Pre-heating and addition of sugar and stabilizers:** Standardized milk is then preheated to 60-650C and added with sugar along with the chosen stabilizers into the milk. The contents are mixed properly.

c. **Filtration:** The contents are properly filtered through stainless steel strainer.

d. **Heating:** The contents are heated at 850C for 10 minutes. However other suitable time–temperature combination can be used.

e. **Cooling:** The contents are cooled to a temperature at which inoculation of the culture can be done. This temperature should be favourable for the culture growth.

f. **Inoculation:** Inoculation is done with 1-2% MD culture (developed by National Dairy Development Board). The culture is specifically chosen as it can tolerate high osmotic process caused by high total solids content including sugar.

g. **Incubation:** Incubation is done till desired pH of about 4.6 is reached. The incubation temperature used should be suitable to the culture used. No whey draining is required after incubation.

h. **Addition of condiments/flavouring substances and mixing:** Addition of carrot shred, mint, tomato powder, salt, vinegar and potassium sorbate as anti-fungal agent (preservative-optional to increase shelf-life) is carried out. The contents are mixed properly and homogeneously with the help of planetary mixture. Other combinations of fruits, vegetables, spices, chocolate, fruit pulp, fruit preserves, etc. may be used.

i. Packing and storage: The product is packed hygienically in polypropylene cups and stored at refrigeration temperature (below 40C). Other suitable packaging material may be used.

Product	Dahi Spread	Butter	Margarine	Fat spread	Mayonnaise	Cheese spread
%Fat	7.5-8.0	80-83	80-83	40-80	20-80	18-30
% Protein	6.5-7.0	0.5-0.9	0-0.5	1-2	0-4	6-12
% carbohydrate	10-11	-	-	-	8-22	0-5
% Total solids	30-34	84-85	84-88	44-84	30-90	40-60
Energy per 100g	120-140	720-750	720-750	360-720	250-700	200-300

* Approximate compositions taken from the available resources.

Table 1 – Comparison with other commercially available spreads*

KEY OUTCOME:

A product has been made using alteration in the *dahi* making process. The product has higher milk protein content than other commercially available spreads except cheese spread. Also, the product has lower fat content than most of commercially available spreads. The detailed comparison is given below in Table 1. It is a vegetarian product (as per the Indian food law) in which major portion of nutrients has been derived from milk source. Different variety of spreads can be made using different condiments, fruits and other flavouring substances. It can be used along with bread, parathas, chapatti, toast, crackers, etc. The results of sensory evaluation have indicated high acceptance of the product among the general population. The product has a shelf-life of 15 days when packed in polypropylene cups and stored at refrigeration temperature (4°C or below). However, its shelf-life can be increased to 2 months at refrigeration temperature by use of preservatives.

RELEVANCE OF THE TOPIC ON THE FUTURE OF THE DAIRY SECTOR

Presently there are various types of spreadable products available in market, majority of which are either milk solids based or from vegetable fat origin. The products which come under this category are butter, margarine, fat spreads, mayonnaise, cheese spreads and other similar products.

Spreads are generally an integral part of meals, snacks & breakfast and this has led to their steady growth. Global food spread market is expected to register a CAGR of 3.5% during the forecast period, 2017 to 2022. (Mordor Intelligence, 2018). The global food spreads market is set to be of worth USD 15.6 billion by the end of 2015 (Business Wire, 2018). A rising health consciousness among consumers has paved the way for low calorie spreads having high protein content.

AUTHORS

Vishal Trivedi, Harendra Pratap Singh, Lalita Oraon, Ketan Dave, Aditya Jain, DK Sharma,
Product and Process Development, National Dairy Development Board, Anand, Gujarat, India.
vbtrivedi@nddb.coop

REFERENCES

Business Wire (2018). Research and Markets: Global Food Spreads Market Worth USD 15.6 Billion by 2020 – Analysis, Technologies & Forecasts 2015-2020. https://www.businesswire.com/news/home/20151221005677/en/Research-Markets-Global-Food-Spreads-Market-Worth Last accessed 13 December 2018.

Mordor Intelligence (2018). Global Food Spread Market – Growth, Trends and Forecasts (2018 – 2023) https://www.mordorintelligence.com/industry-reports/global-food-spreads-market-industry Last accessed 13 December 2018.

INTERNATIONAL DAIRY FEDERATION
70/B, Boulevard Auguste Reyers
1030 Brussels - Belgium
Tel: +32 2 325 67 40
Fax: +32 2 325 67 41
Email: info@fil-idf.org

@fil-idf

www.fil-idf.org