HOW TO IMPROVE YOUR COLOSTRUM QUALITY

-EXISTING KNOWLEDGE AND NEW TOOLS

The Danish Cattle Conference 2024 – Tuesday 1:00 pm – Session 61

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WHY IS THE PASSIVE IMMUNIZATION SO DARN IMPORTANT?

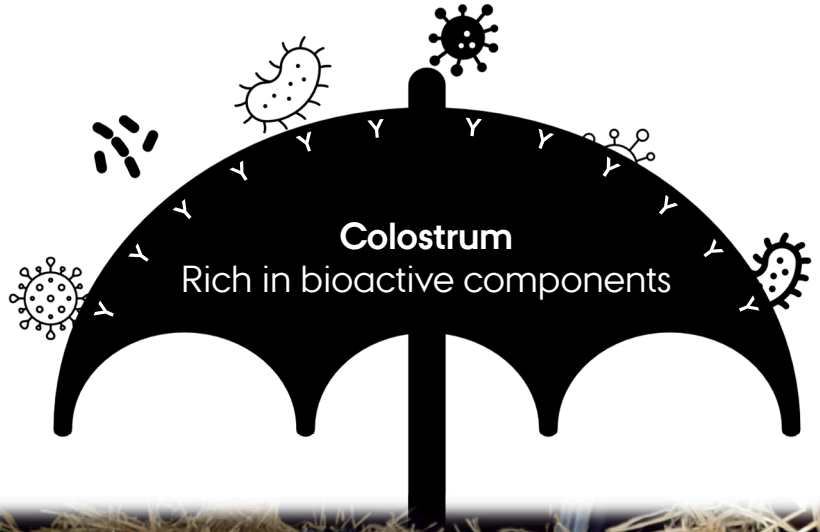
Enhances the immunological defense mechanisms

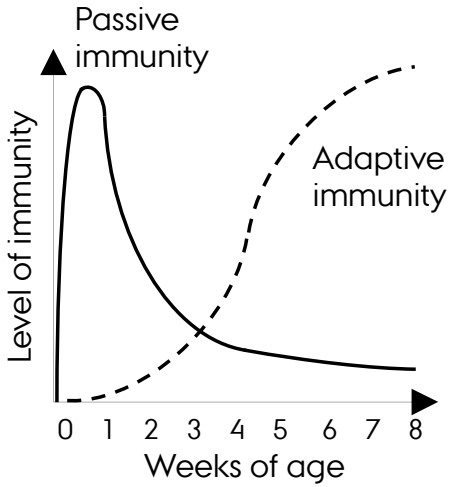
Prone to diseases

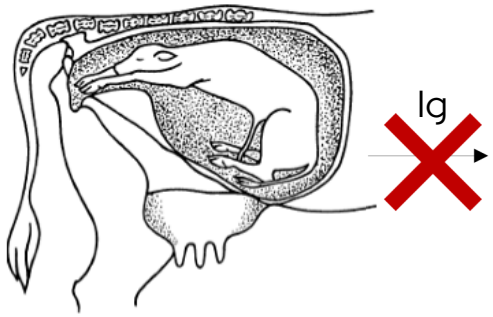
Protection against external pathogens

Colostrum contributes to

- Passive immunization
- Immune maturation
- Intestinal development
- Nutrient supply







Adaptive immunity

A specific defense mechanism

Immunoglobulin production

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WHEN THE PASSIVE IMMUNIZATION FAILS

-due to inadequate or low transfer of antibodies

Consequences

↑ Morbidity
Mortality
Antimicrobial use
Culling rate

↓ Welfare
Health and gut health
Intestinal development
Average daily gain
Milk yield

Prevention rather than treatment

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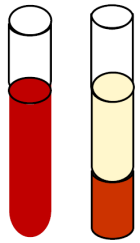
EVALUATION OF THE PASSIVE IMMUNIZATION

Evaluation og the passive immunization

- Focuses on the absorption of IgG in serum
- Evaluate 24 hour to max 7 days after colostrum



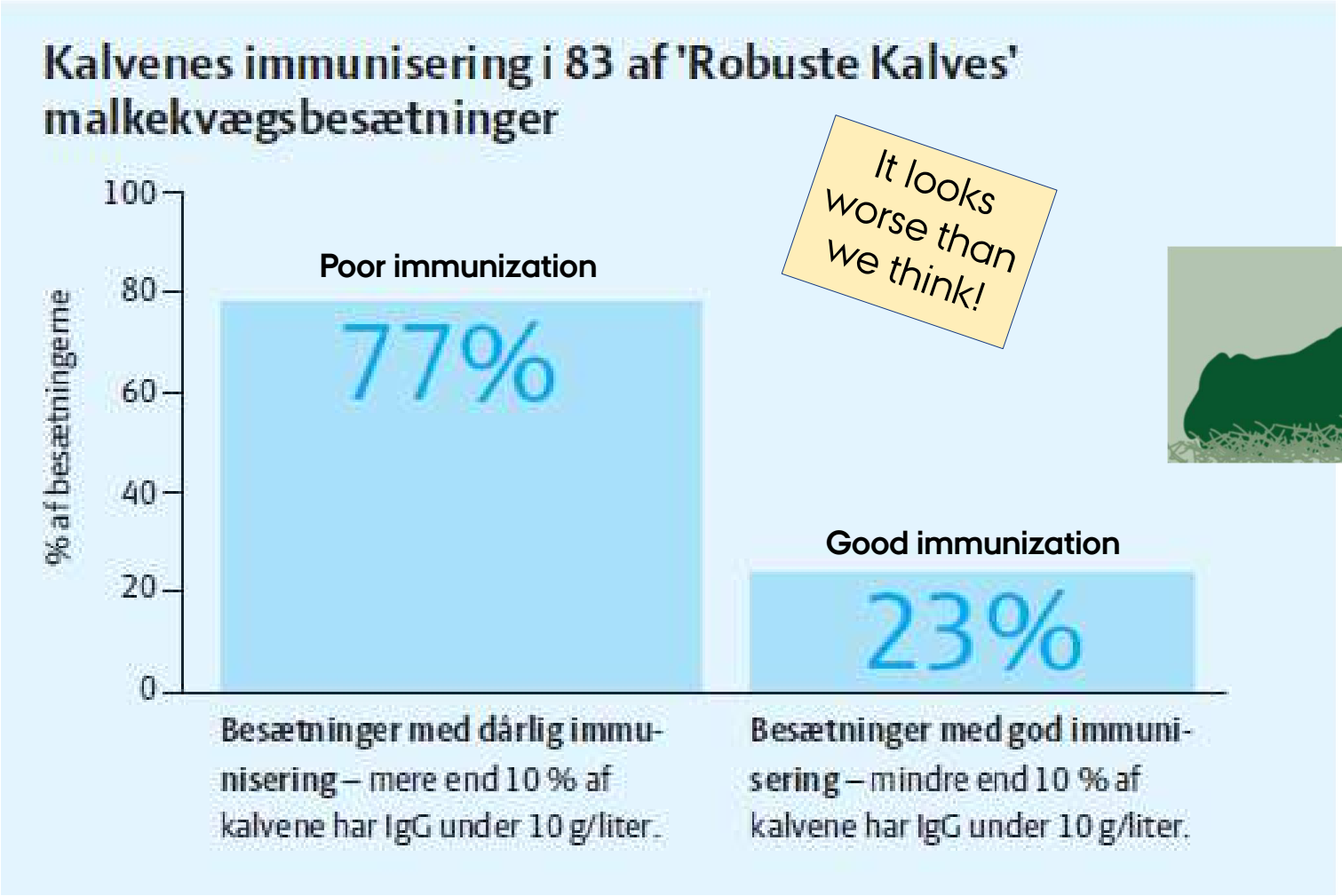
Blodet centrifugeres, og serum udtages

Recommended distribution in IgG-categories

IgG category	Serum IgG mg/mL	Serum Brix %	Recommendation % af kalve
Excellent	≥ 25.0	≥ 9.4	>40
Good	18.0-24.9	8.9-9.3	~30
Fair	10.0-17.9	8.1-8.8	~20
Poor	< 10.0	< 8.1	<10

Recommendations set high demands for quality of colostrum and management

HOW IS THE IMMUNIZATION OF OUR CALVES PROGRESSING?



It looks worse than we think!

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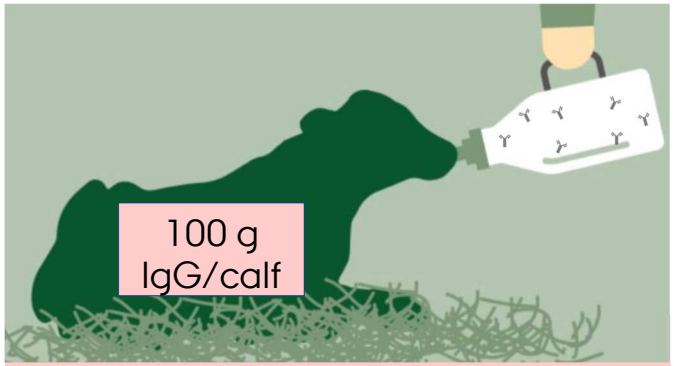
THE DEFINITION OF HIGH-QUALITY COLOSTRUM

High level and provision of IgG (antibodies)

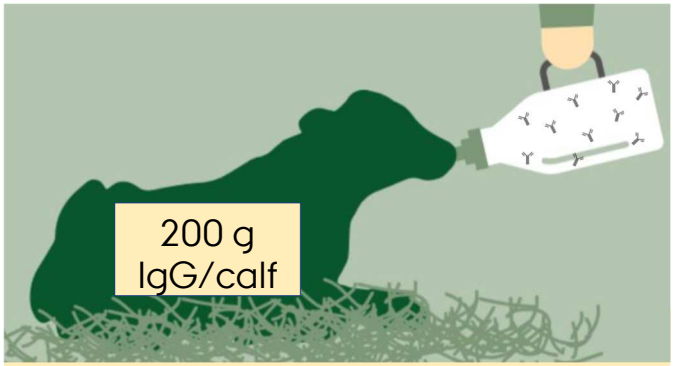
- Measure the quality by a refractometer
- Evaluate the quality
- Feed the calf 8-10 % colostrum of birth weight
- Feed colostrum < 2 hours after birth

IgG category (HOL)	IgG mg/mL	Brix %	Ingestion at 4 L colostrum g IgG/kalv
Excellent	> 100	26	400
Good	75	24	300
Fair	50	22	200
Low	< 25	19	100

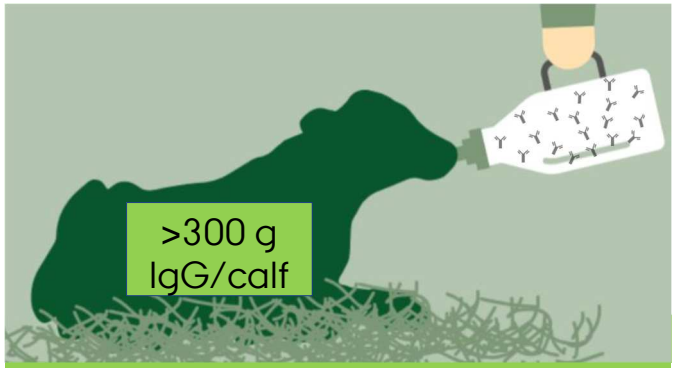
Note: All colostrum is valuable, and nothing should be discarded!



High risk of poor immunization



Fair probability of fair immunization



High probability of excellent immunization

Colostrum must be bacteriologically clean

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VARIATION IN THE QUALITY OF COLOSTRUM ACROSS DANISH HERDS

38 Danish dairy farms; 650 colostrum samples; Black line: Average Brix%; Cut-off level of Brix% 22

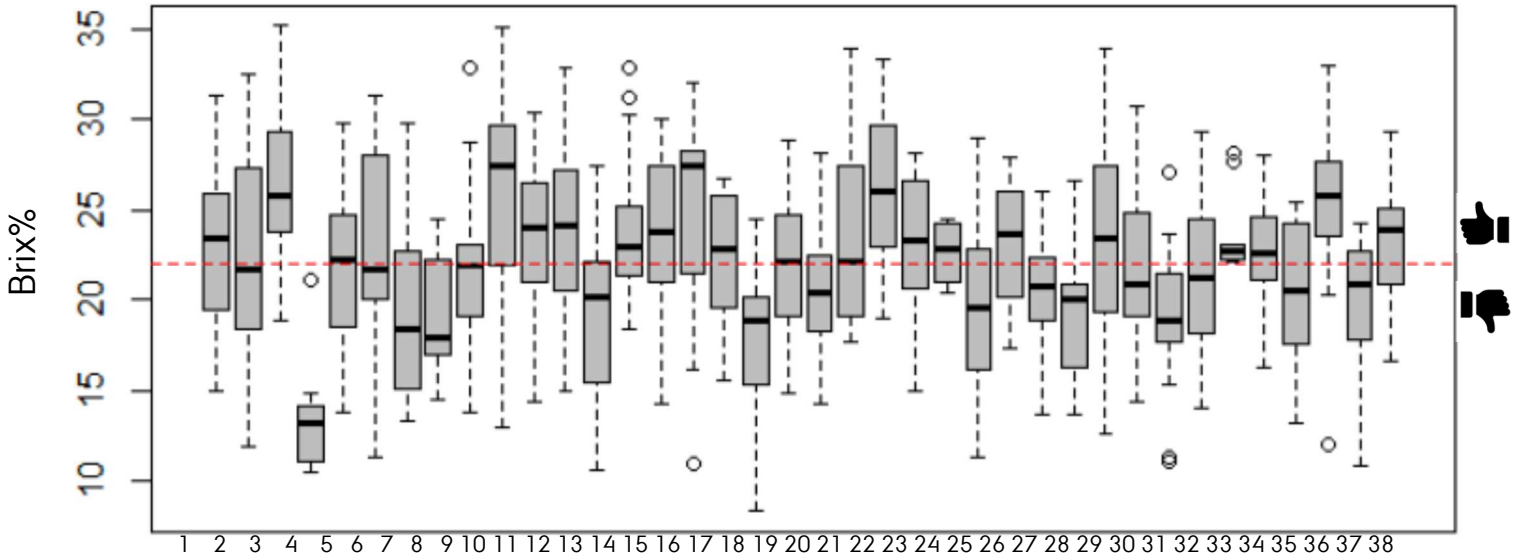

Figure directly copied from Meier (2015)

Herd variation in colostrum Brix%

- Great variation within and across herds (Brix% 8.3 - 35.1)
- Low-quality prevalence: 41 %

Colostrum available for calves

- Insufficient high-quality colostrum to supply all newborn calves

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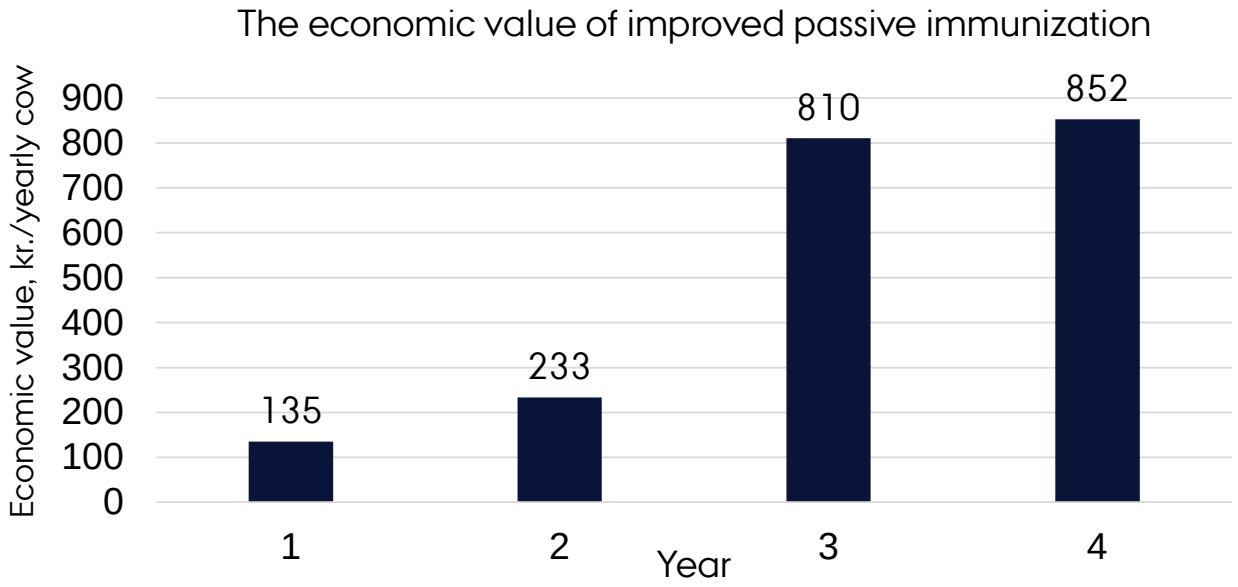
THE ECONOMIC VALUE OF LOW VERSUS HIGH PASSIVE IMMUNIZATION

Potential in enhancing passive immunization from poor to okay or better	Unit	Value
Calf diarrhea (- 66 %)	kr./yearly cow	100
Calf mortality (- 62 %)	kr./yearly cow	223
Average daily gain in breeding heifers (-10 % calving age)	kr./yearly cow	360
Longivity (- 46 % replacement rate before 2nd lactation)	kr./yearly cow	523
Milk yield (+10 % i 1st lactation og +17 % i 2nd lactation)	kr./yearly cow	1.577
I alt	**kr./yearly cow**	**2.782**

Economic potential when the proportion of calves achieving high passive immunization increases from 50 to 90%

High passive immunization is a long-term investment

- *Full benefits are achieved after 4 years*



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Adequate supply of high-quality colostrum is the foundation for your future dairy cows and slaughter calves

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FACTORS AFFECTING COLOSTRUM QUALITY AND QUANTITY

The production of colostrum

- Prepartum transfer of IgG from maternal circulation into mammary secretion
- Begins 3-5 weeks prior to parturition
- Controlled by endocrine regulation

Factors associated with quality and quantity

	Improvement of management
Breed	👎
Parity	👍
Length of dry period	👍
Time of colostrum milking	👍
Milk yield in previous lactation	👍
Prepartum feeding	?
Seasonal effects	?
Stress	?

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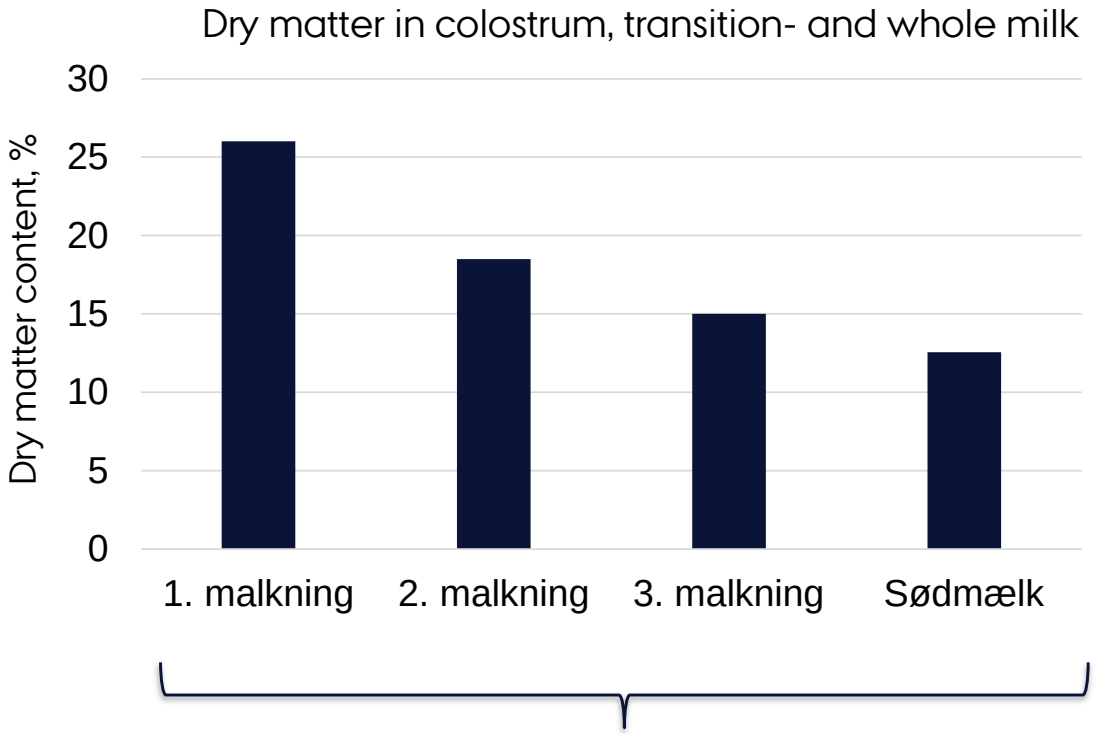
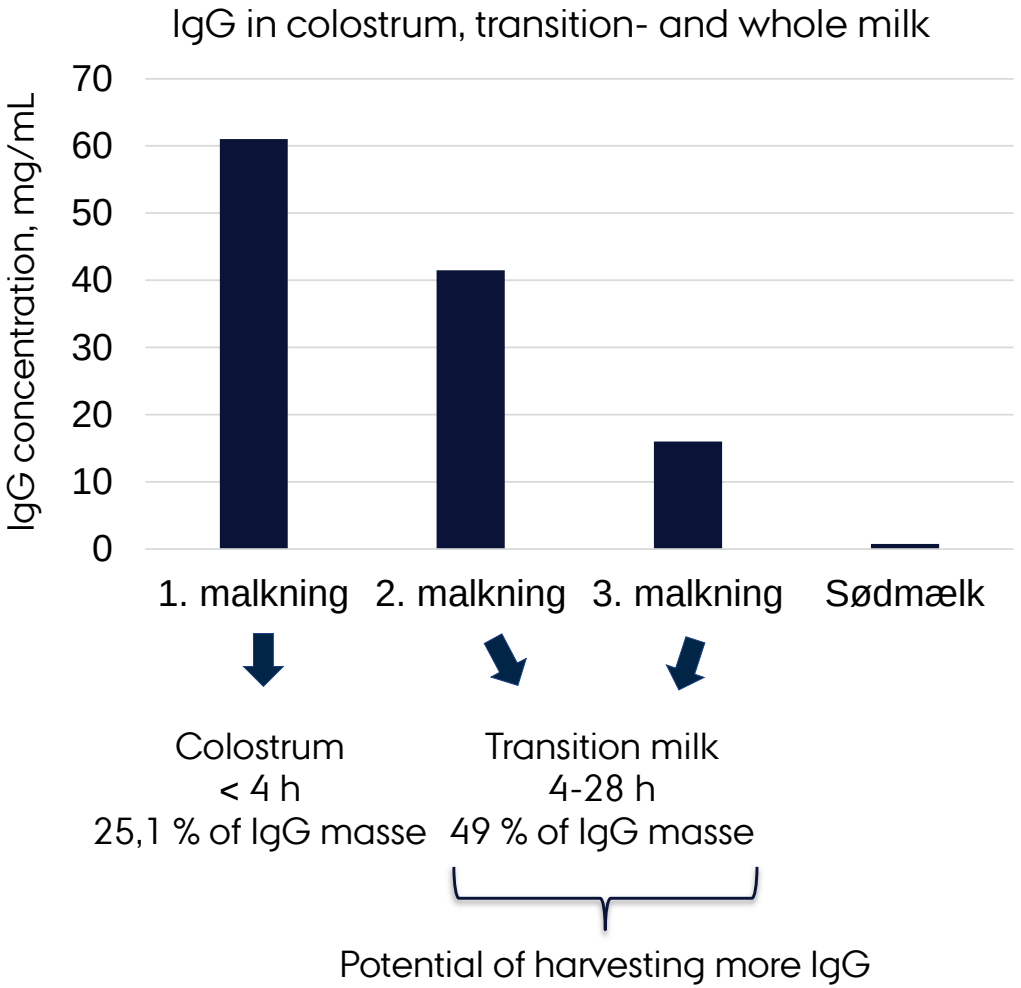
LET'S TAKE A LOOK INTO THE COMPOSITION OF COLOSTRUM



Colostrum and transition milk have an increased concentration of

Nutrients

Bioactive compounds



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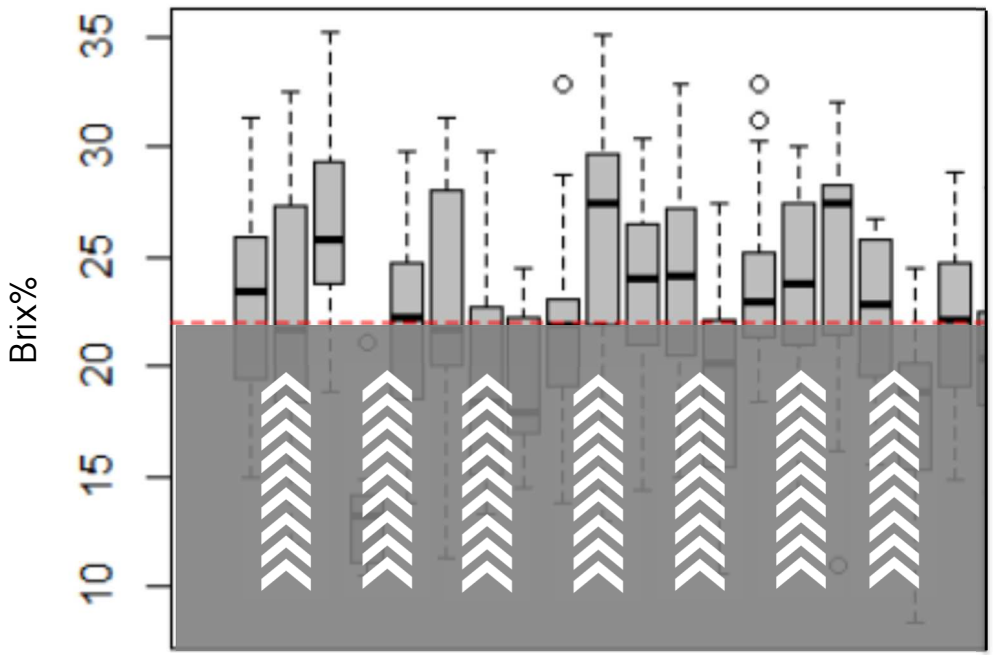
ALTERNATIVE OPTIONS TO IMPROVE QUALITY OF COLOSTRUM

Increase the concentration of IgG in colostrum



Possible methods

Supplementation or complete replacement with

- Dried colostrum
- Colostrum replacers/substitutes

Advantages

- Increase the concentration of IgG in poor colostrum
- Improves the IgG delivery to calves

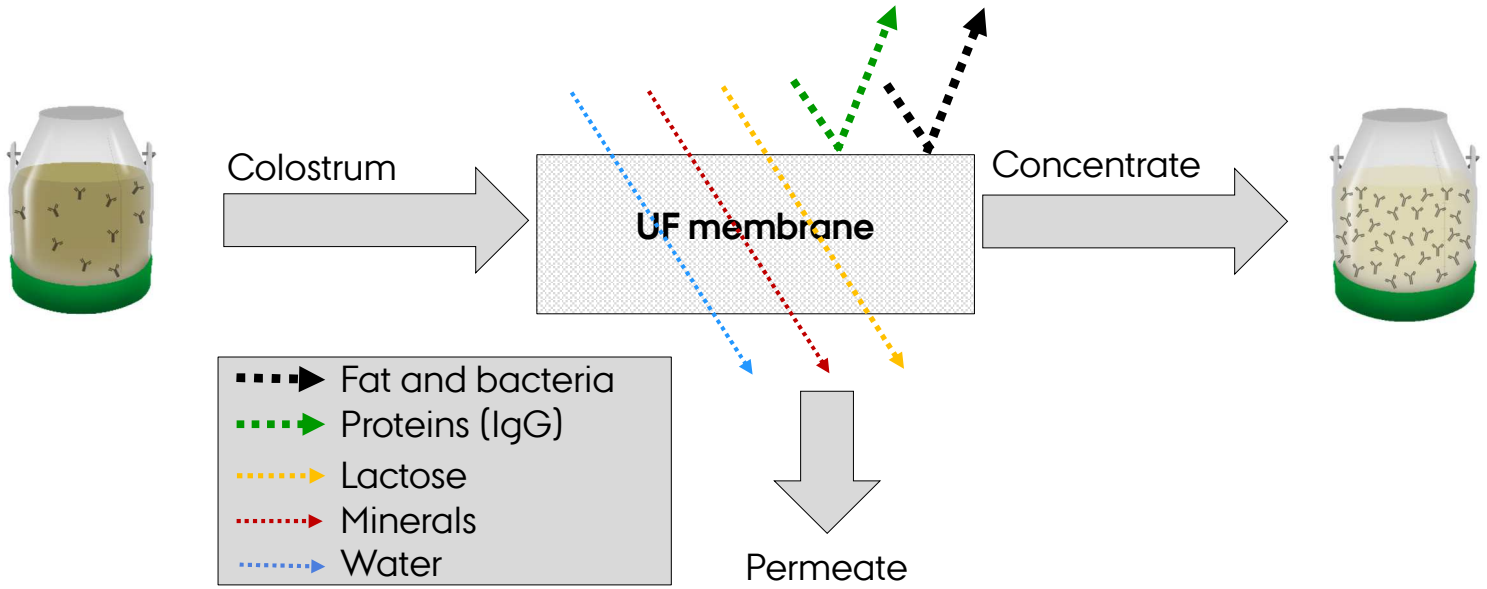
Disadvantages

- Products cannot replace natural high-quality colostrum
- Deficient of low in bioactive components
- Impairs IgG absorption
- Colostrum from other farms and countries
  - Unspecific IgG's
- Production requires many steps of processing (expensive)
  - **Ultrafiltration: Concentration of IgG**

OPTIONS FOR THE USE OF ULTRAFILTRATION (UF) OF COLOSTRUM

The ultrafiltration technology

- Concentrate and fractionate liquids

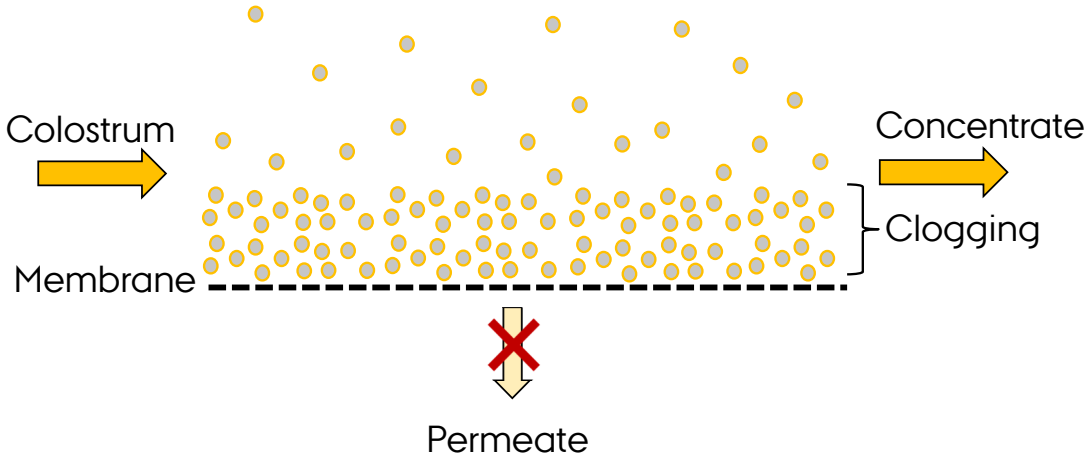


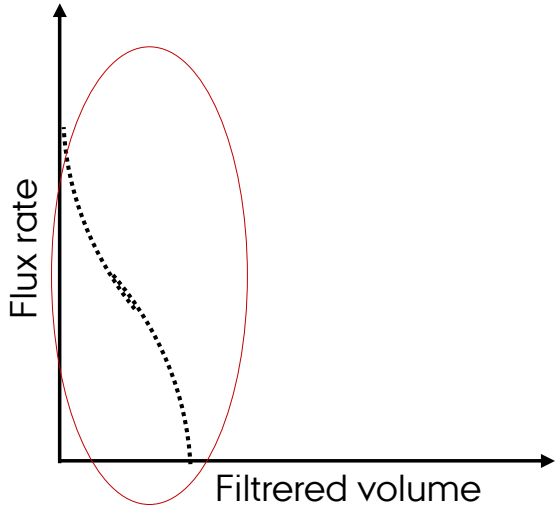
Significant disadvantage

High viscosity of colostrum ➡ High risk of clogging the membrane

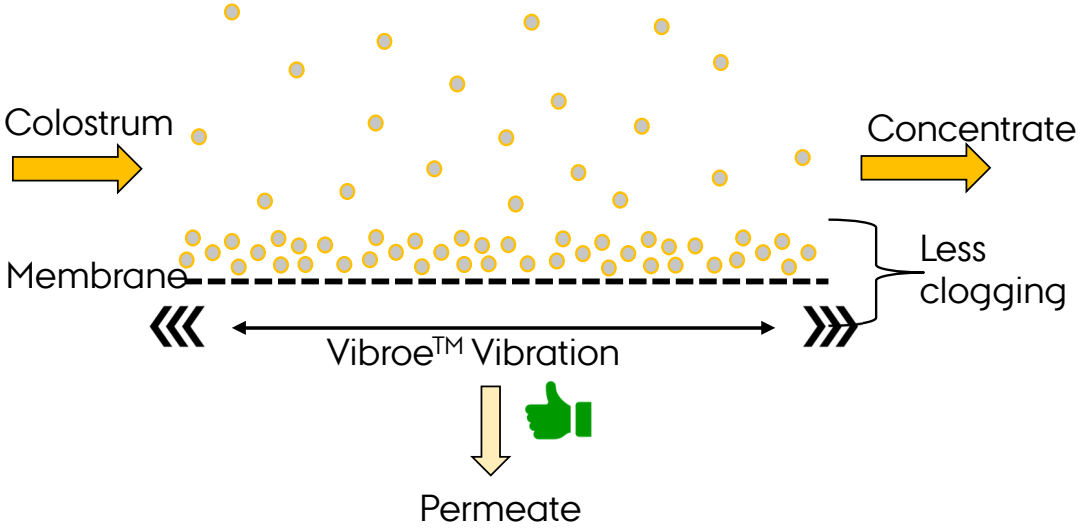
THE VIBRATION TECHNOLOGY REDUCES THE RISK OF CLOGGING THE MEMBRANE

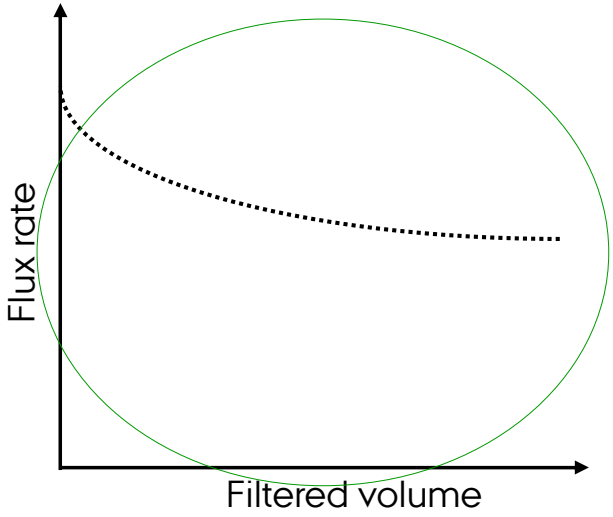
Regular ultrafiltration





Ultrafiltration with vibration technology





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THE EFFECT OF ULTRAFILTRATION OF COLOSTRUM HAS BEEN STUDIED IN A Ph.D. PROJECT

HYPOTHESIS

Ultrafiltration enhances the immunological properties of low-quality colostrum and makes it as effective as high-quality colostrum

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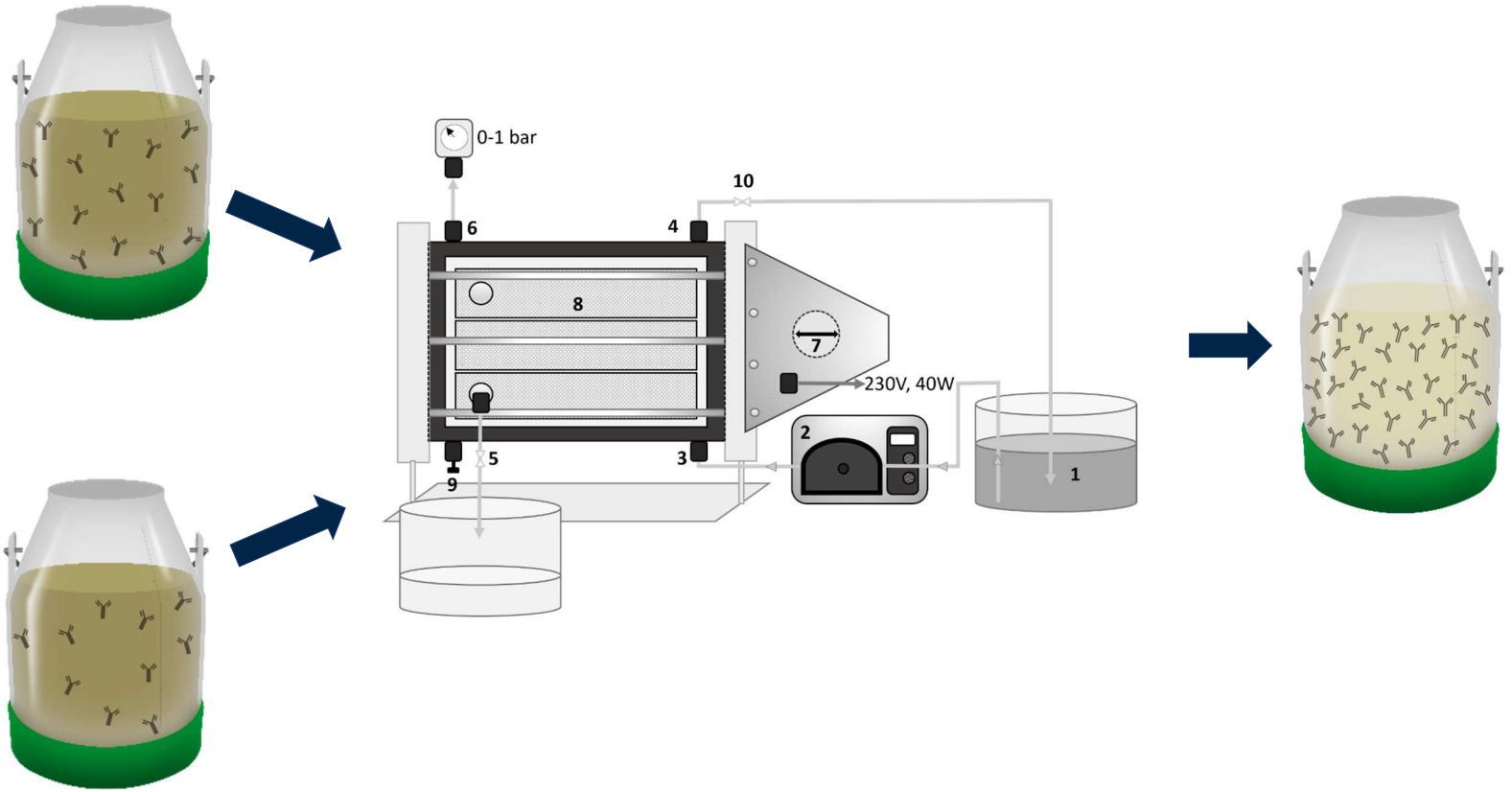
TEST: CAN WE TURN POOR COLOSTRUM GOOD?

37 % colostrum
(1st milking)

81 samples
Brix% 12-25

63 % transition milk
(2nd milking)



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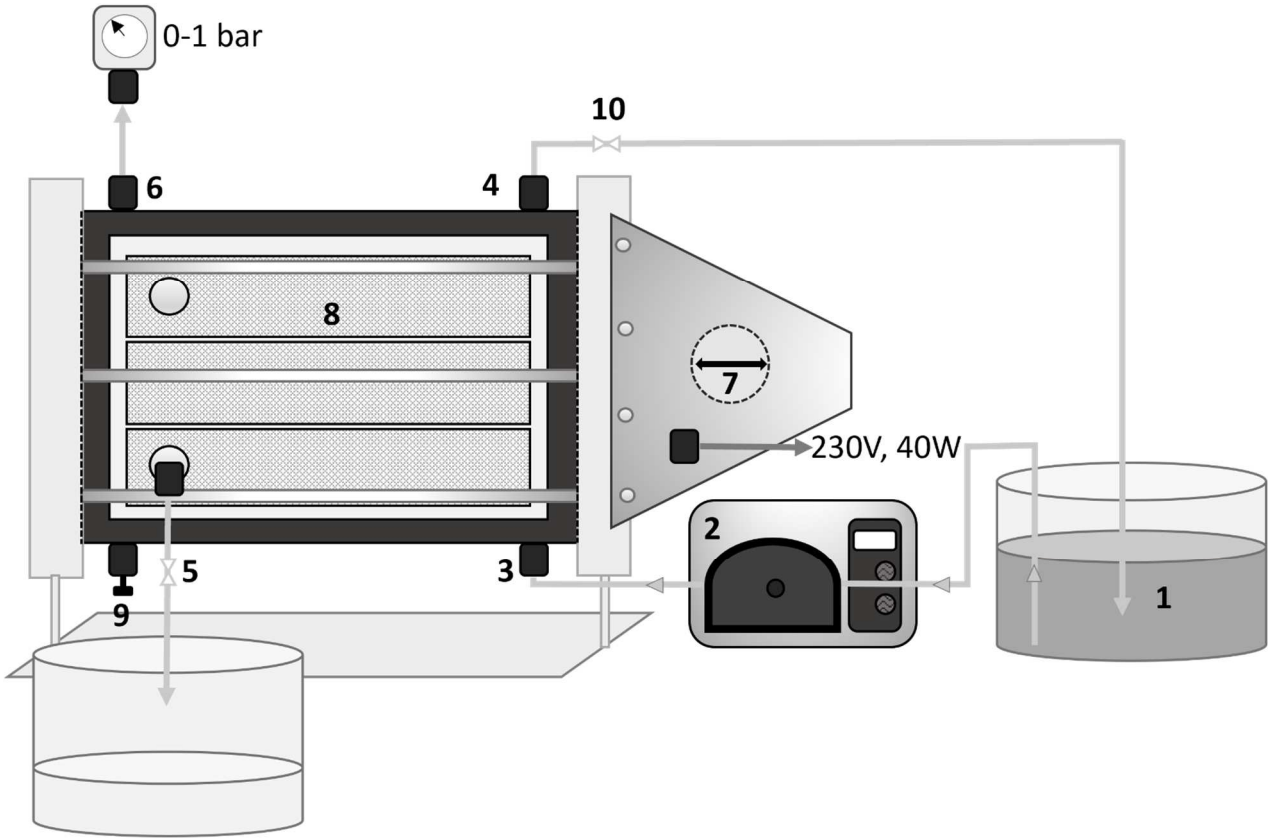
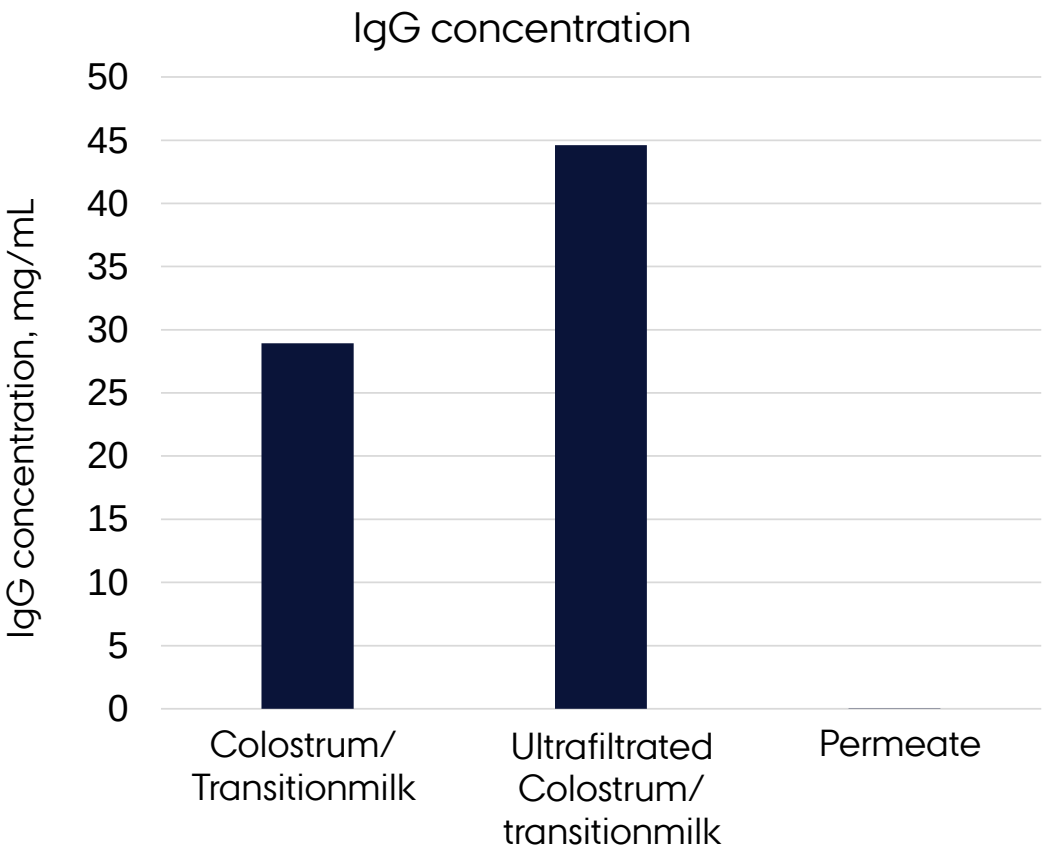
EQUIPMENT AND METHOD FOR ULTRAFILTRATION

Sani Membrane Vibro™-LE system



1: Feed tank (Colostrum)
2: Peristaltic pump
3: Feed in
4: Concentrate out
5: Permeate out
6: Manometer (0-1 bar)
7: Vibration motor (1,500 rpm)
8: Membrane chamber (areal 0.35 m^2)
9: Dead end (plugged)
10: Retentate (RET) out regulator

CHANGED COMPOSITION OF COLOSTRUM BY ULTRAFILTRATION



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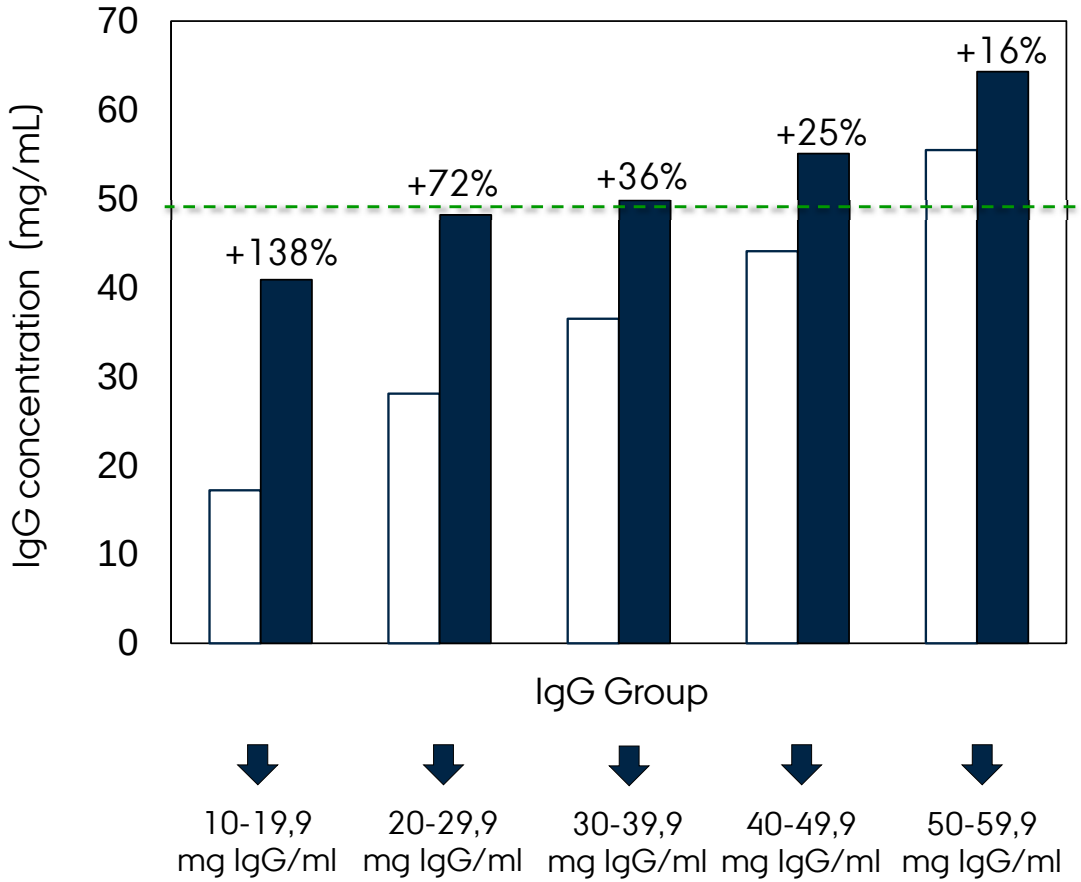
COLOSTRUM/TRANSITION MILK SUITABLE FOR ULTRAFILTRATION



High-quality colostrum

Colostrum/transition milk

Ultrafiltrated colostrum/transition milk

Colostrum/transition milk with IgG levels as low as 20 mg/mL can achieve high-quality status

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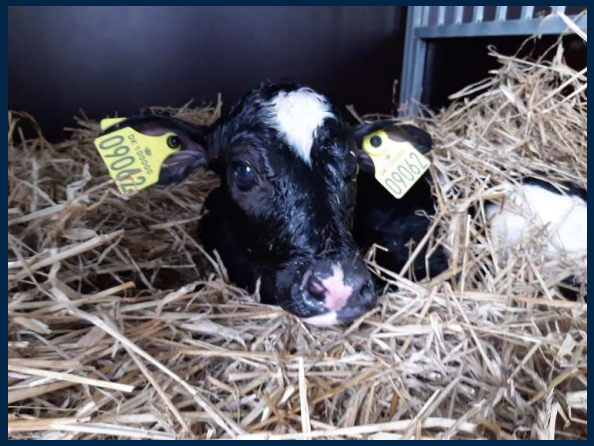

CALF STUDY

Aim

To assess the short-term effects of feeding newborn calves ultrafiltrated colostrum/transition milk on their:

Transfer of passive immunity
Health
Productivity

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CALF STUDY: EFFECT OF FEEDING ULTRAFILTRATED COLOSTRUM

48 x

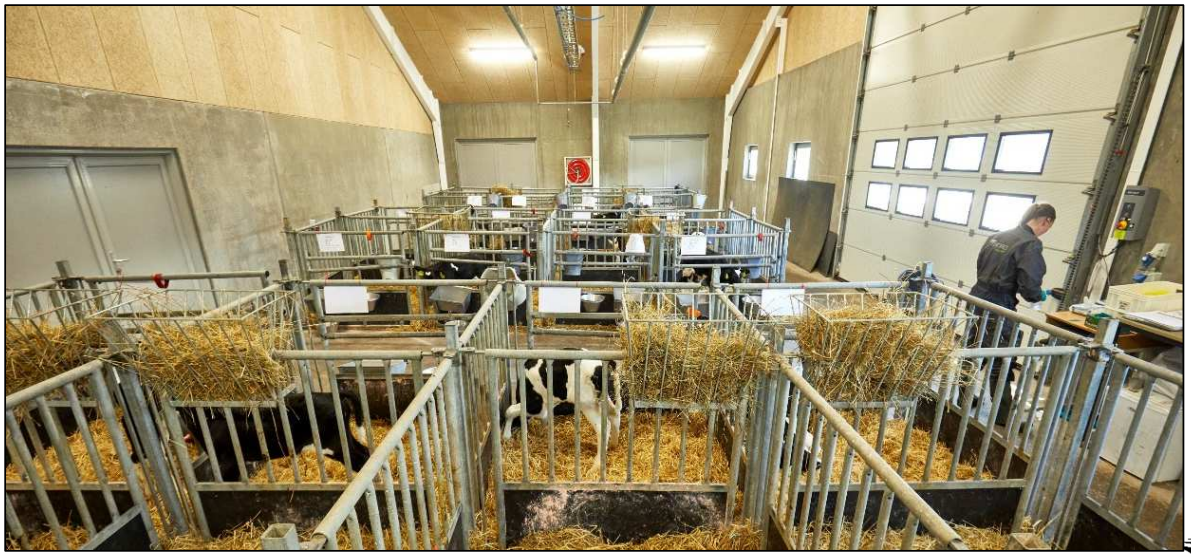
Non-processed high-quality colostrum (CC)

Ultrafiltrated low-quality colostrum/transition milk (UFC)

From birth to 28 days of age

Housing

- Single pens with straw
- Ad libitum access to water, calf pellets and hay
- Fed 2 x 4 L of milk replacer/day



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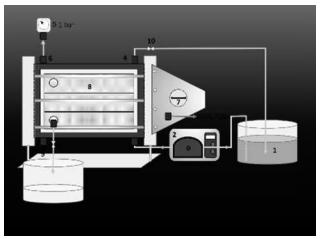
COLOSTRUM TREATMENTS

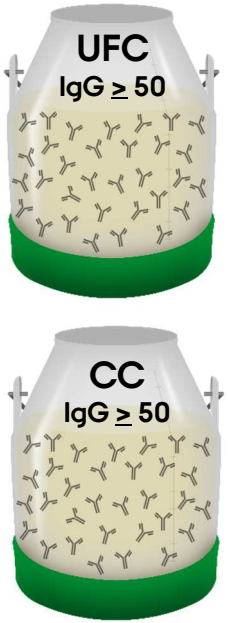
Input
Colostrum and transition milk
Brix%15-21 (< 50 mg IgG/mL)

Ultrafiltering



Output
High quality colostrum

Brix% > 22 (≥ 50 mg IgG/mL)



Heat treatment
60°C for 60 min.

Storage
-18 °C

Feeding
10% of birth bodyweight

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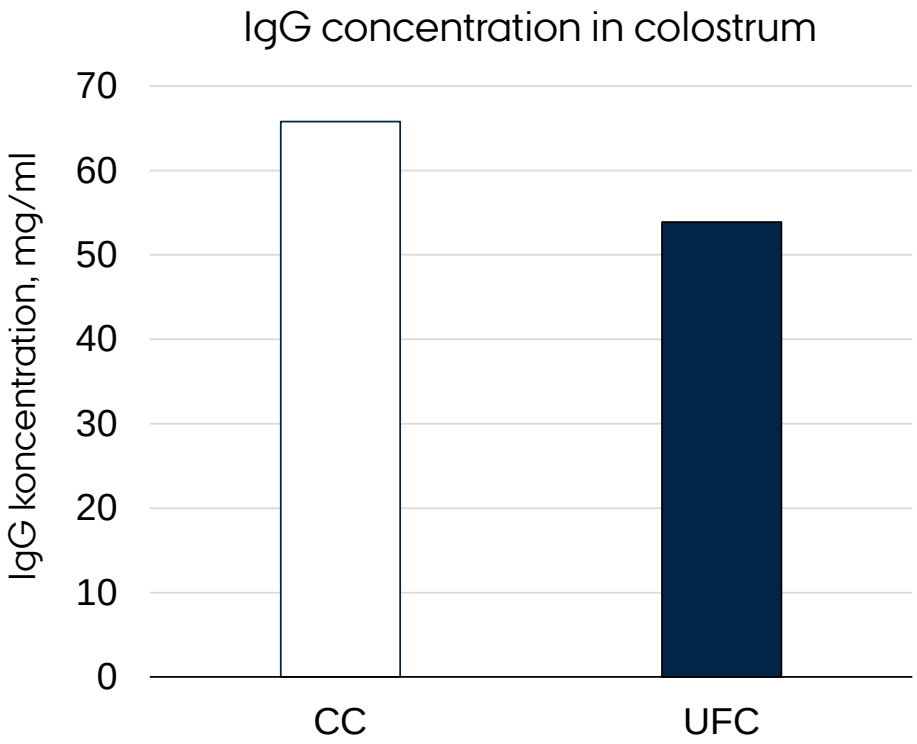
COLOSTRUM TREATMENTS



Non processed high-quality colostrum

Ultrafiltrated low-quality colostrum/transition milk

Reasons for higher IgG concentration in control colostrum:

CC = "Only colostrum of high quality“

IgG estimated via Brix%

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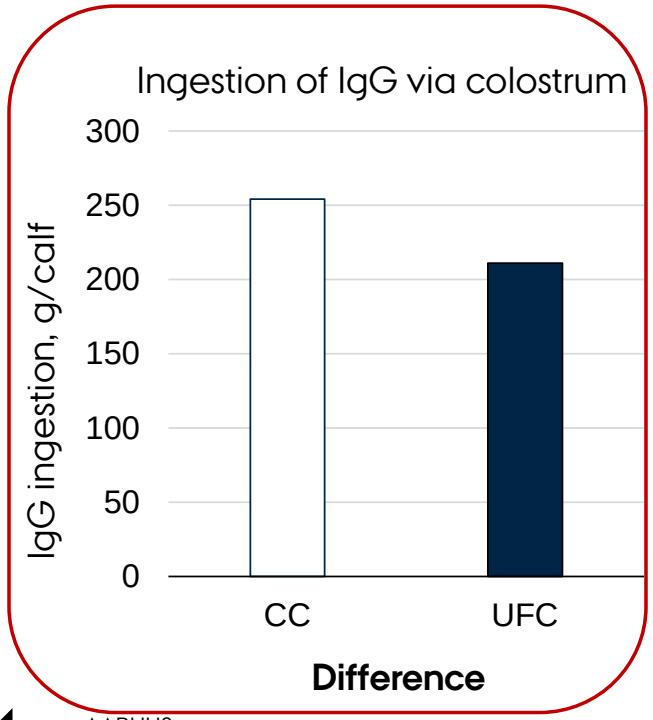
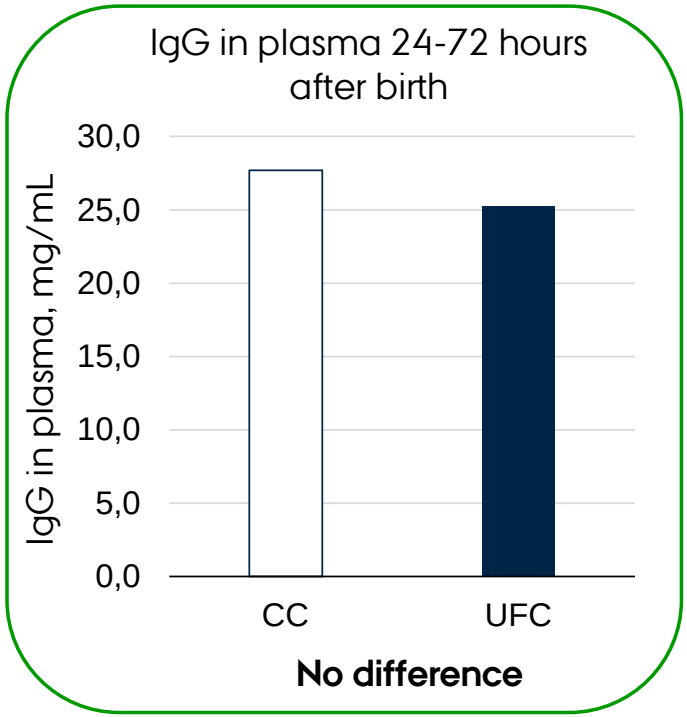
RESULTS FOR THE PASSIVE IMMUNIZATION OF CALVES

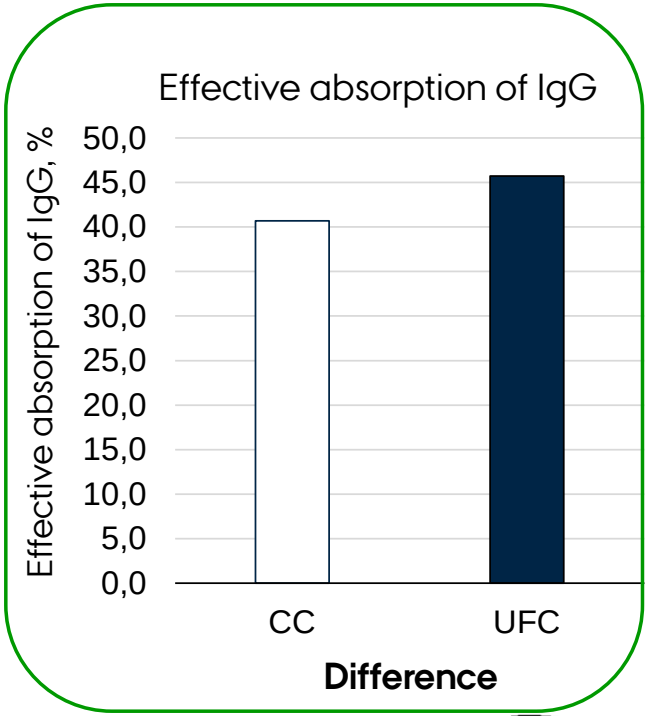
- No difference in birth bodyweight and VIGOR
- Calves consumes colostrum 1.5 hours after calving (no difference)
- Blood samples were taken 50 hours after colostrum intake (no difference)

Non-processed high-quality colostrum

Ultrafiltrated low-quality colostrum/transition milk







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DISTRIBUTION OF CALVES IN PASSIVE IMMUNITY IgG CATEGORIES

No calves in the poor category

- Fair to excellent
- 60 % of the calves in the excellent category

No effect of colostrum treatments

IgG category	Serum IgG	Recommendation	**Calf study**
	mg/mL	% of calves	% of calves
Excellent	>25.0	>40	**60**
Good	18.0-24.9	~30	**29**
Fair	10.0-17.9	~20	**11**
Poor	<10.0	<10	**0**

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EFFECT OF COLOSTRUM TREATMENTS ON HEALTH AND PRODUCTIVITY

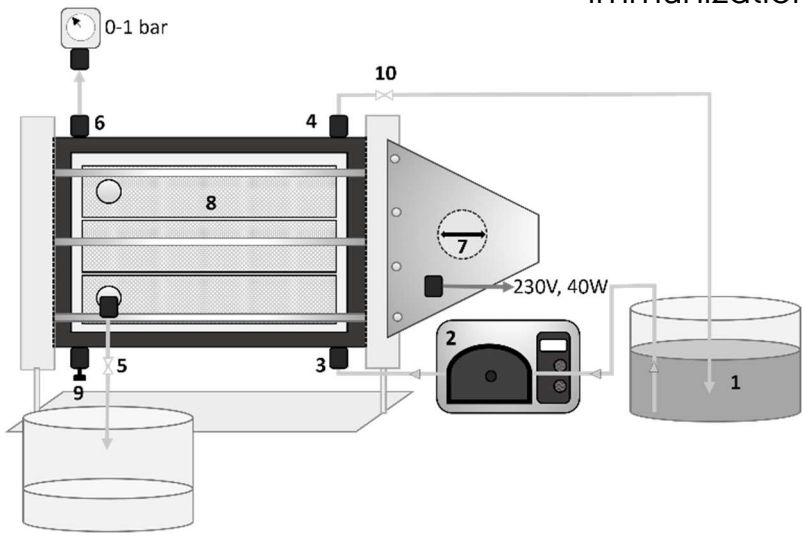
No difference in the measured health parameters

No difference in feed intake, feed efficiency and average daily gain

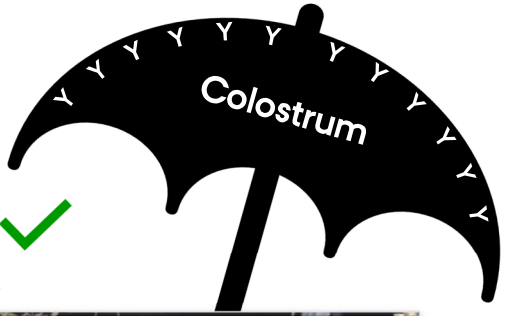
ADG (0-28 d)
789 g/day

FROM THESE STUDIES, WE NOW KNOW THAT

We can increase the IgG in low-quality colostrum by ultrafiltration technology ✓



We can achieve a successful passive immunization of calves ✓



We know how specific analyzed components of colostrum changes ✓

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THE QUALITY OF COLOSTRUM CAN BE IMPROVED THROUGH ULTRAFILTRATION

THEN, WHAT NOW?

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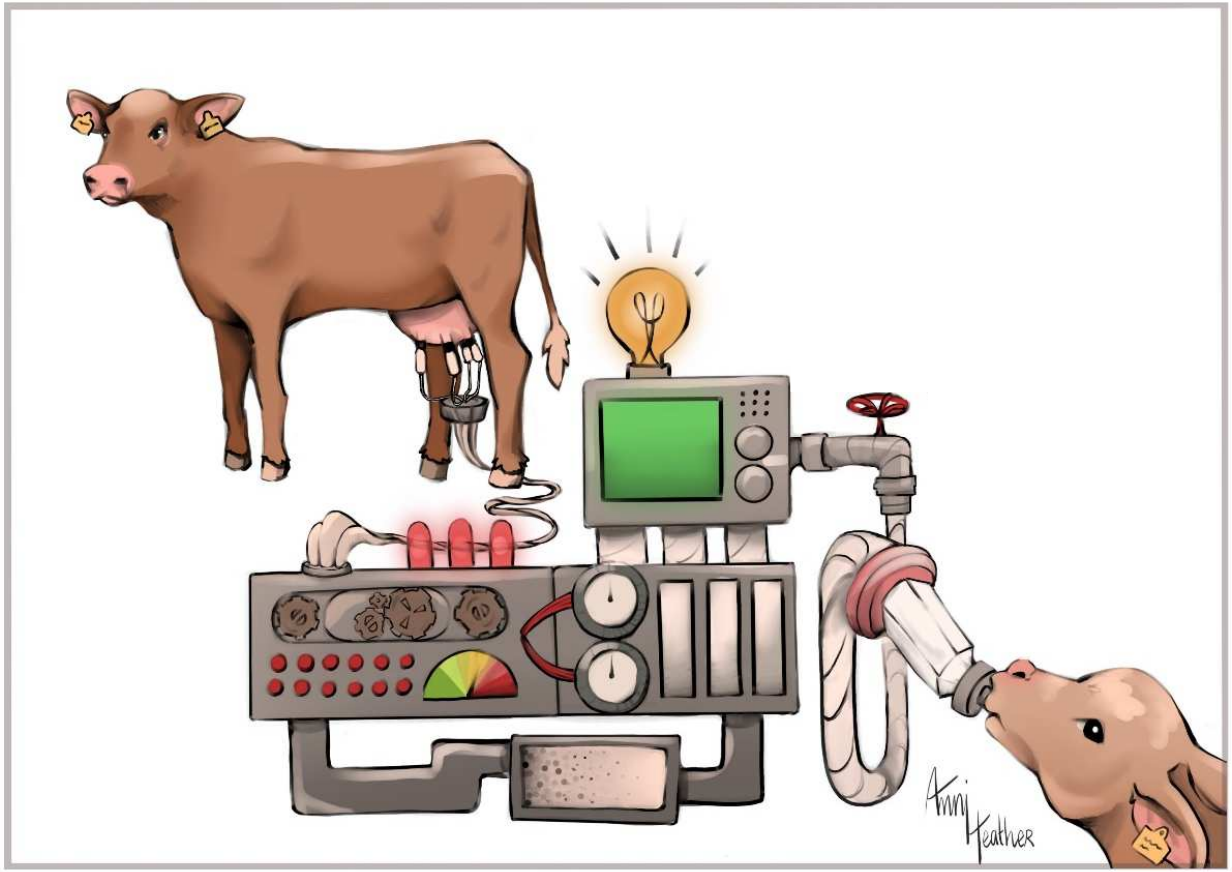
ON-FARM IMPLEMENTATION OF ULTRAFILTRATION?



On-farm ultrafiltration equipment

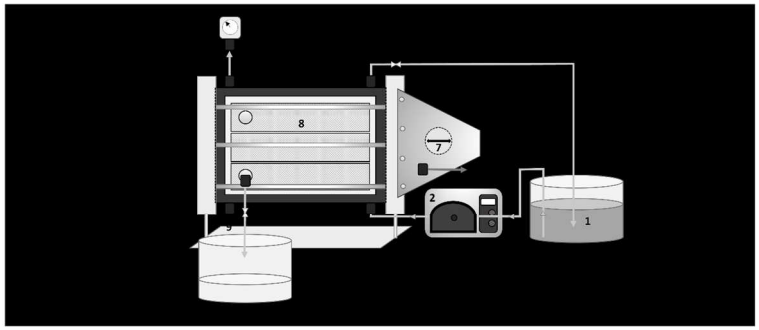
- Colostrum/transition milk is milked from the cow
- Quality is measured (Brix%)
- Colostrum is fed into a machine, which concentrated IgG
- High-quality colostrum is harvested and stored in a colostrum bank until use

This case requires technical development of equipment

- Automation of various procedures

IMPLEMENTATION THROUGH A TRANSPORTABLE SOLUTION – A SUBSCRIPTIVE SERVICE?

Ultrafiltration of colostrum “on-farm”

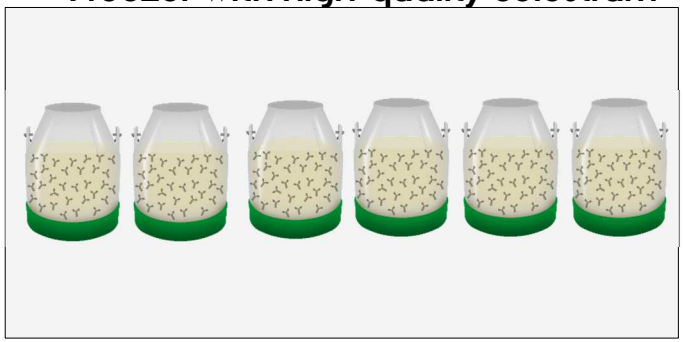


Colostrum service
”Turning silver into gold”

Destination:
Lars the farmer

Freezer with low-quality colostrum

Freezer with high-quality colostrum



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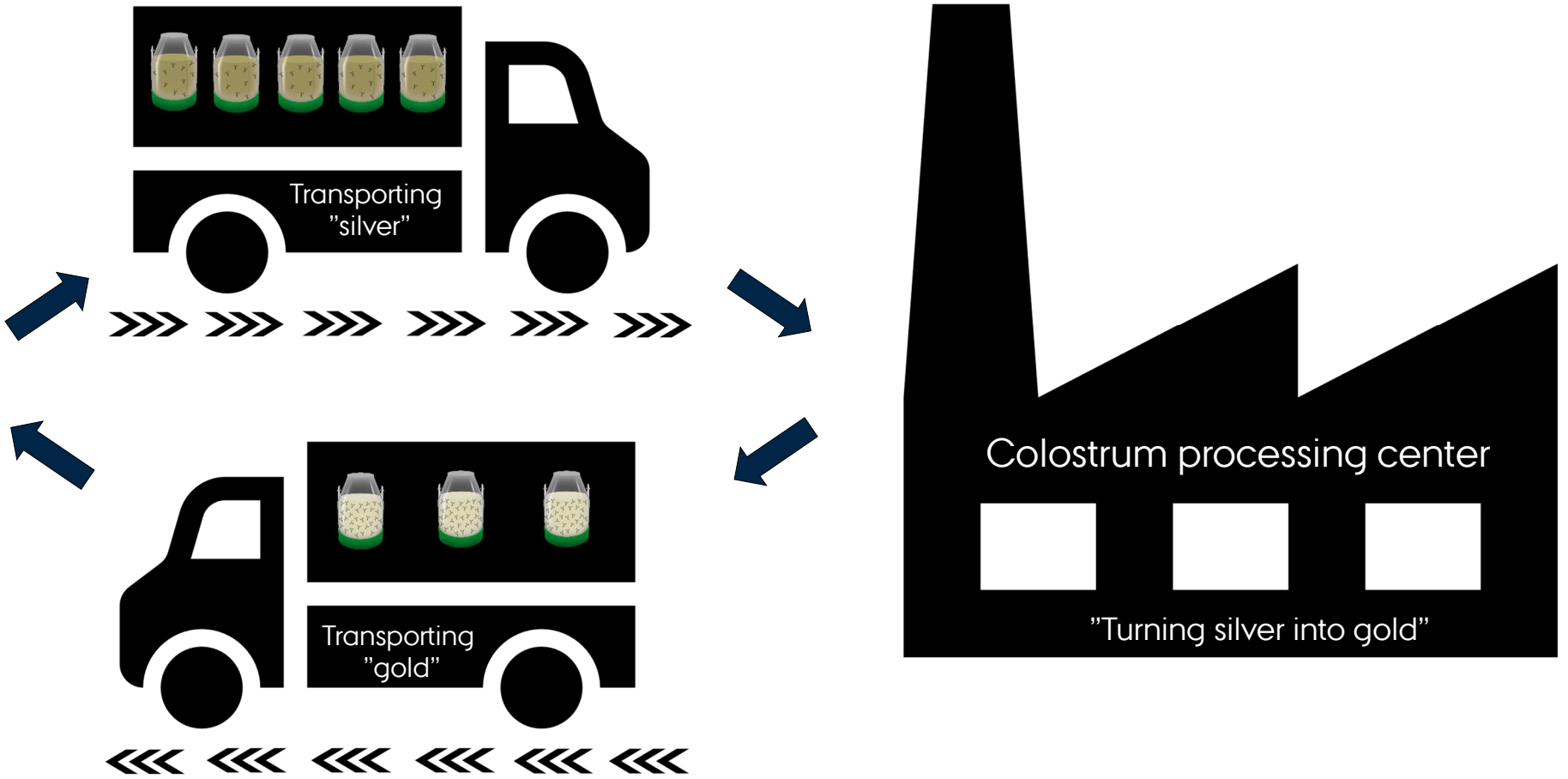
ULTRAFILTRATION THROUGH A ”COLOSTRUM PROCESSING CENTER”?



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TAKE HOME MESSAGES

The quality of colostrum is essential for achieving high passive immunization

- High passive immunization lays the foundation for your future dairy cows and rose-veal calves

The quality and quantity of colostrum can be improved, but:

- Management-related tooled shows inconsistent effects
- Supplementation or replacement with colostrum products cannot replace natural colostrum

Alternative solutions: Improving quality of colostrum through ultrafiltration

- Enriches colostrum and transition milk in IgG
- Using both 1st and 2nd milking increased the total volume of high-quality colostrum
- Ensures high transfer of passive immunity to newborn calves, without negative consequences for health and productivity
- Ensures retention of high biological activity of colostrum without negative consequences for intestinal cell growth and wound healing capability

THANK YOU FOR YOUR ATTENTION

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