Milk Quality Workshop
January 2023

TCM, chlorate and microbial status of farm bulk milk – an update

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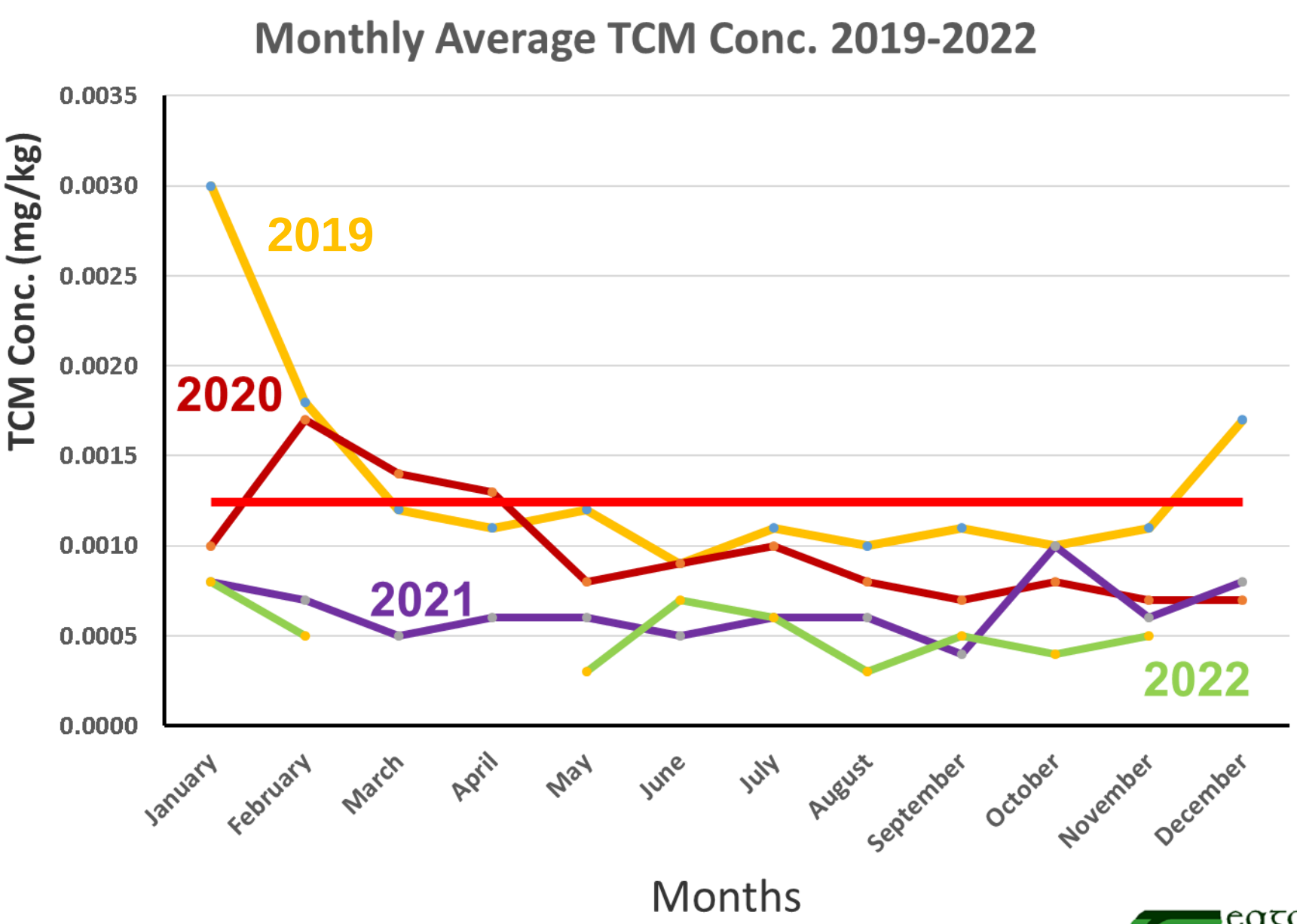
Focus on chlorine residues and microbial status of bulk milks

- **Chlorine** used for (i) disinfection of milking machine/ bulk tank surfaces on-farm and processing equipment at factory (ii) disinfection of water

- Associated with 2 residues
  - **TCM**
  - **Chlorate**

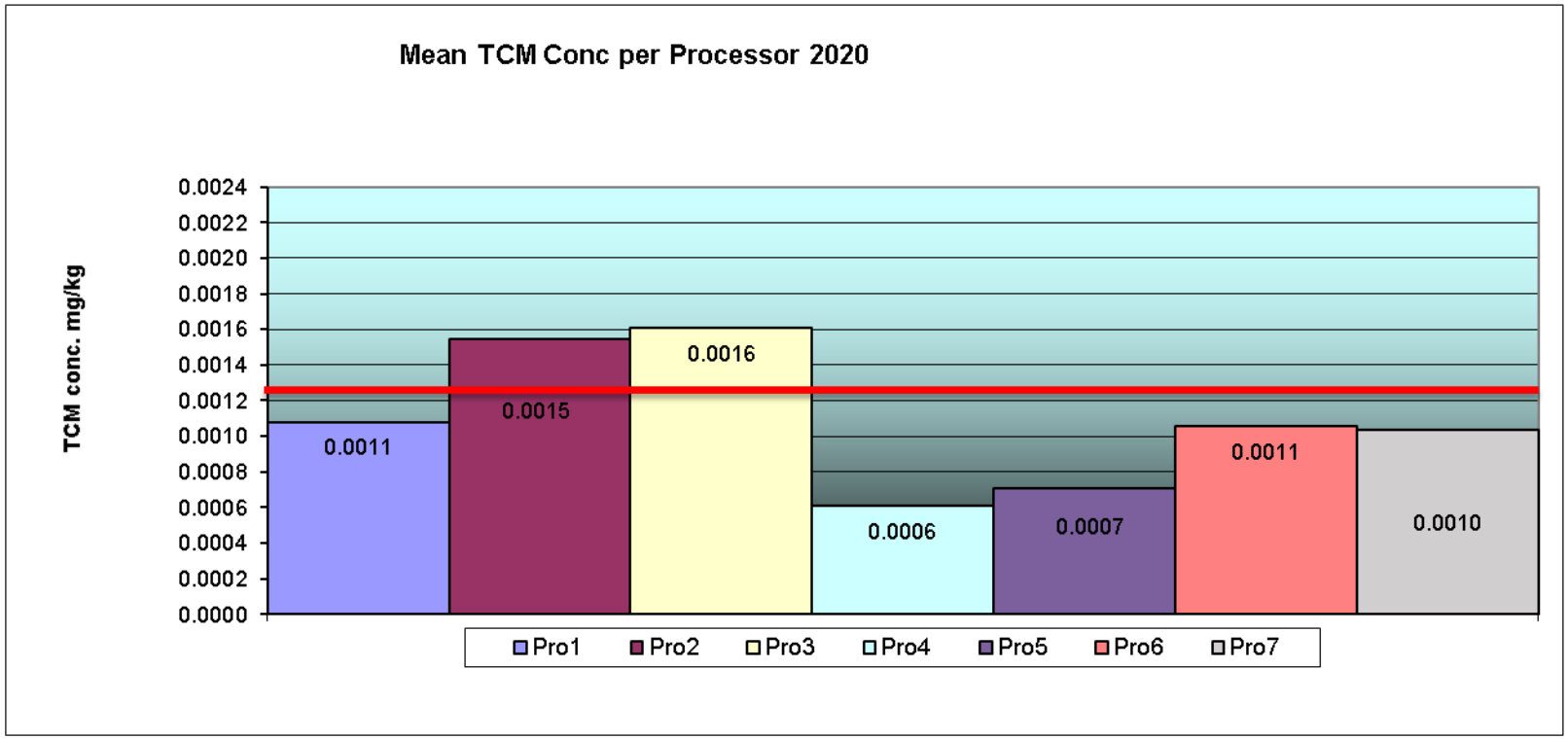
  - **TCM levels** – suggested carcinogenic effects – levels need to be controlled and maintained, international market for butter must be protected – target 0.024 mg/kg in butter; 0.00124 mg/kg in milk

- **Chlorate**: suggested issue with prevention of iodine uptake – particularly critical for milk powder as ingredient to IMF – EU MRL <0.01 mg/kg as consumed - <0.002 mg/kg in milk
- Requirement to remove chlorine from the milking machine/ bulk tank cleaning on-farm and equipment within processing sites (Jan 2021)
- But removal of chlorine must not lead to a deterioration in microbial quality of milk
- Have consulted with processors on microbial quality of milk and measurement of any change occurring in parallel with the removal of chlorine from the cleaning protocol


Monthly Average TCM Conc. 2019-2022
TCM Conc. (mg/kg)
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
2019
2020
2021
2022
January
February
March
April
May
June
July
August
September
October
November
December
Months

Mean TCM levels in milk 2020 (Jan – Dec)

Industry Average= 0.00109mg/kg
Weighted Average= 0.00104mg/kg



Target 2020 0.00124 mg/kg

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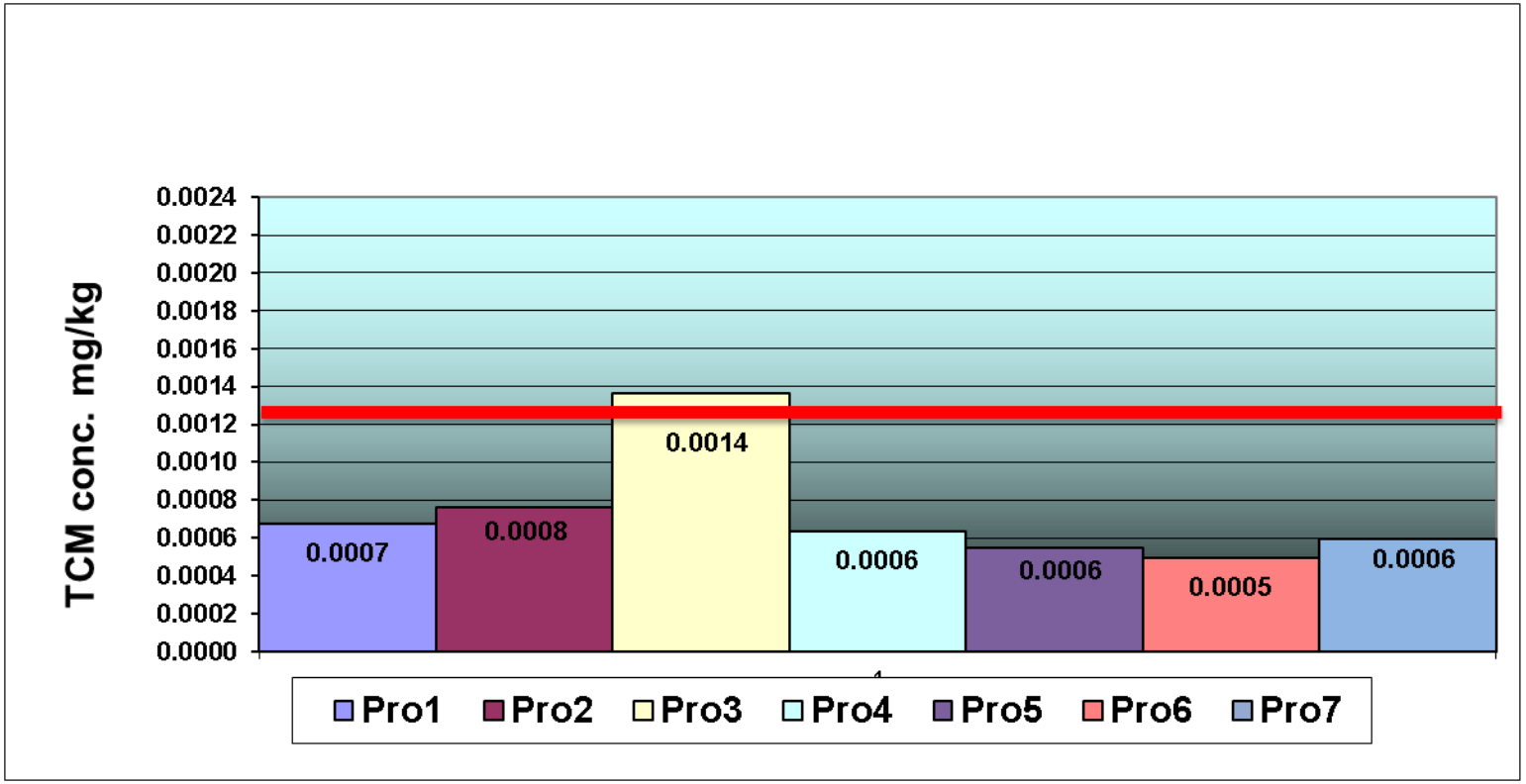
Mean TCM levels in milk 2021 (Jan – Dec)

Industry Average = 0.00074mg/kg
Weighted Average = 0.00054mg/kg



Target limit
0.00124mg/kg

- 35 – 40,000 samples tested annually
- Removal of chlorine commenced from Jan 2021

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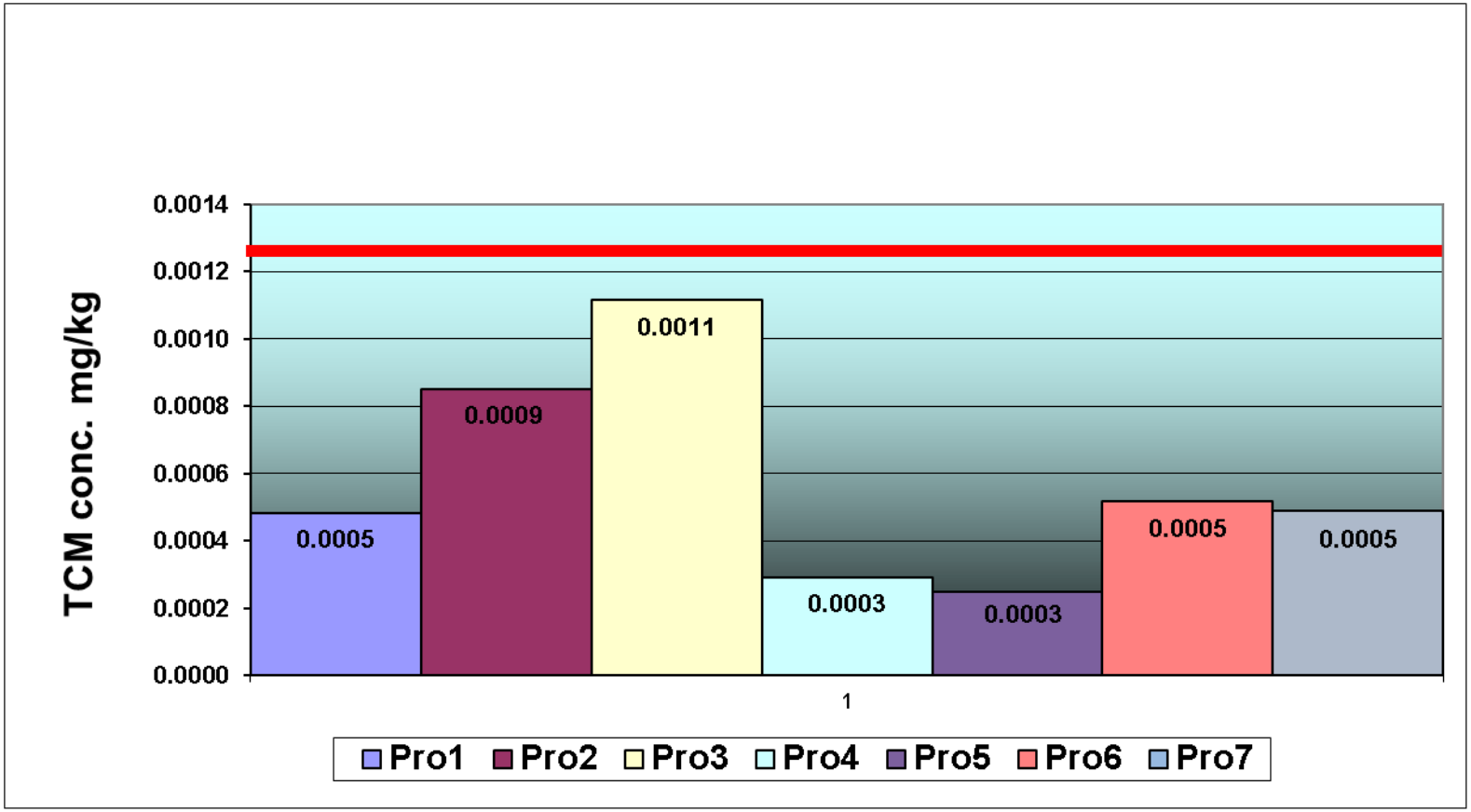
Mean TCM levels in milk 2022 (Jan–Nov)

Industry Average = 0.0006mg/kg
Weighted Average = 0.00055mg/kg



Target limit 0.00124mg/kg

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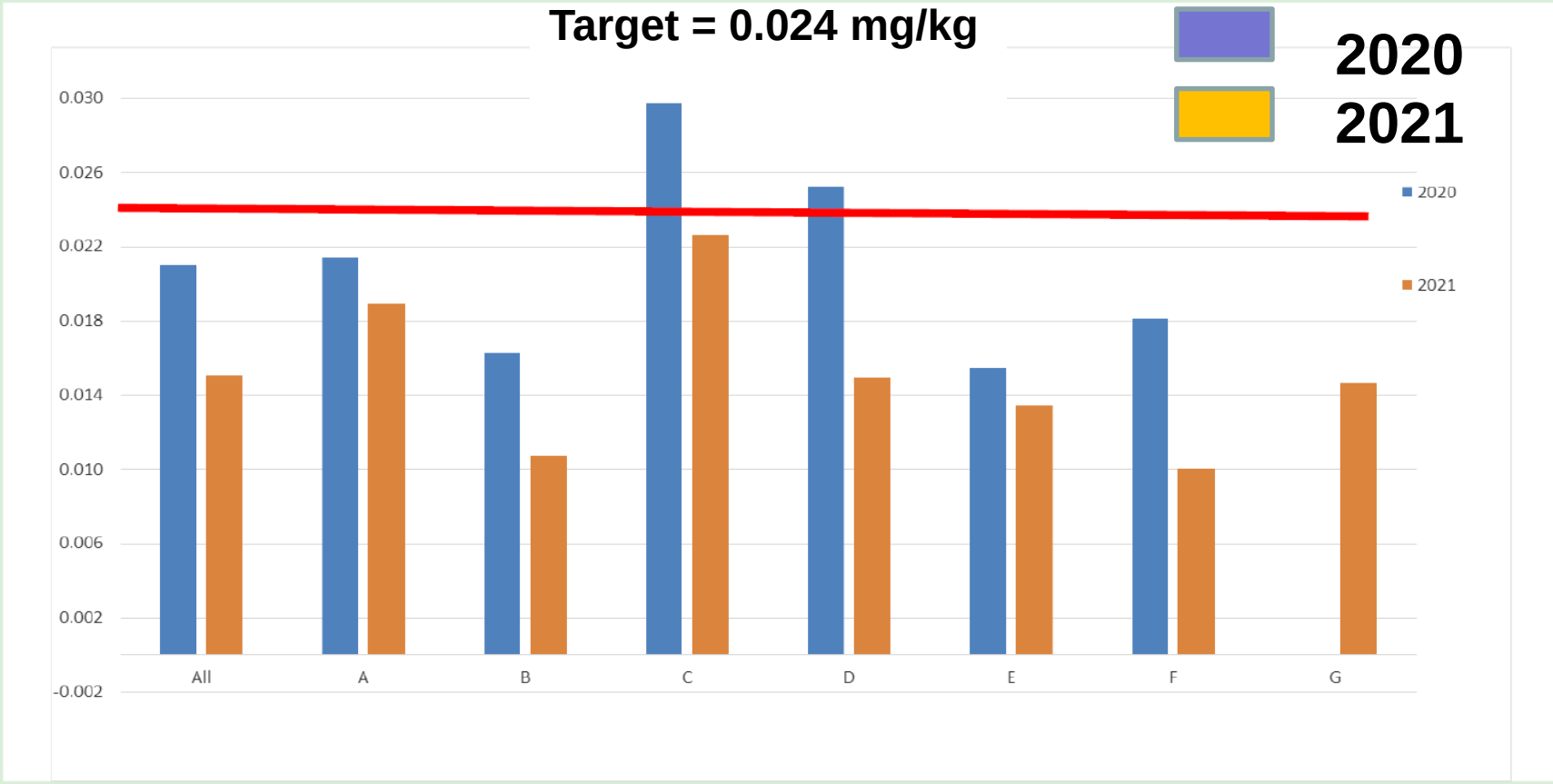
TCM levels in Butter 2020 - 2021



Processors A to G

Ornua
THE HOME OF IRISH DAIRY

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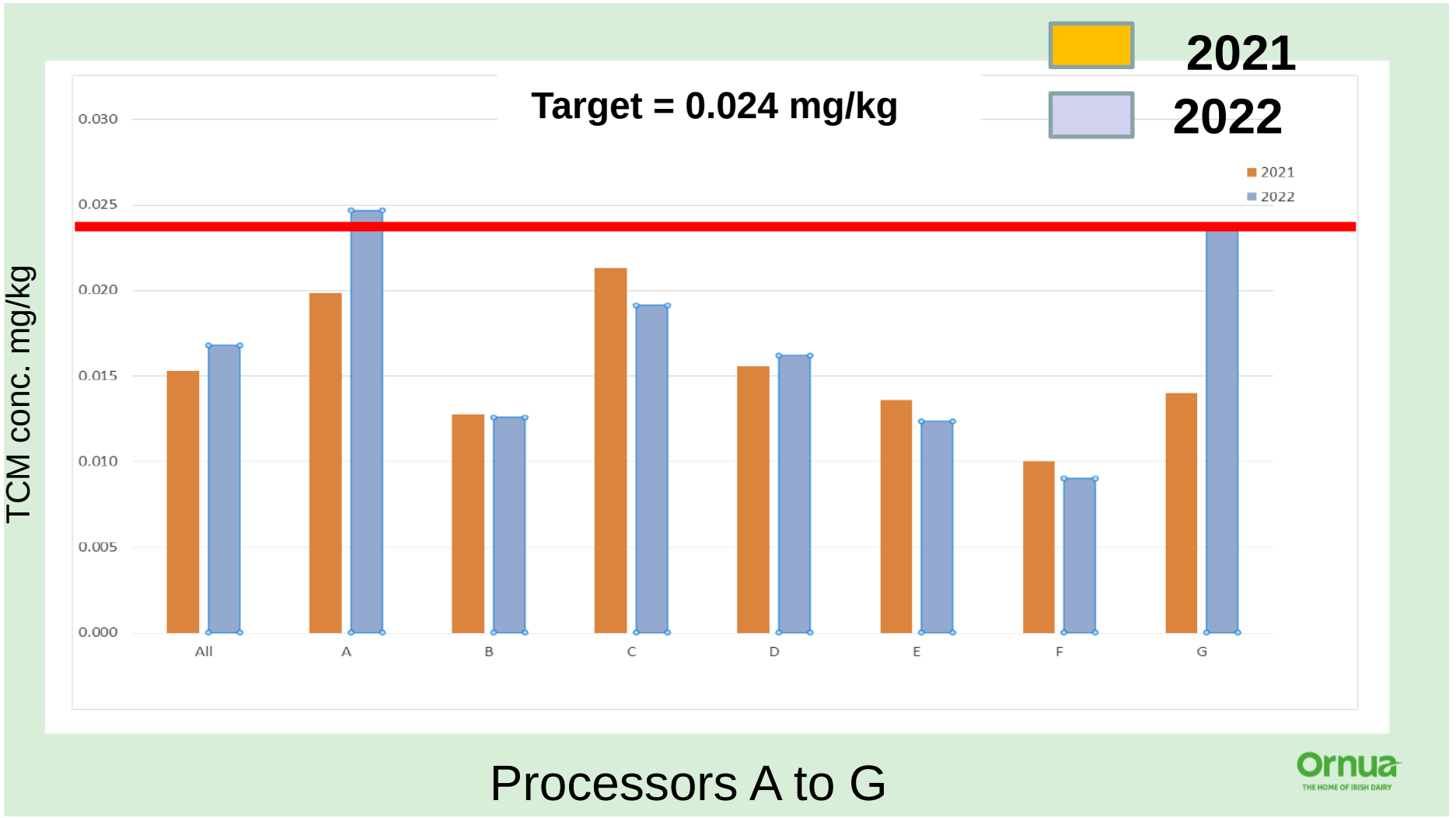
TCM levels in Butter 2021 - 2022



Summary - TCM

Milk

- In 2020 17% of milk samples had TCM levels >0.00124 mg/kg **(Av = 0.00104mg/kg)**
- **Chlorine free cleaning protocols introduced**
- In 2021 9% of milk samples had TCM levels >0.00124 mg/kg **(Av = 0.00054mg/kg)**
- In 2022 (to Nov) 6% of milk samples had TCM levels >0.00124 mg/kg **(Av = 0.00055mg/kg)**

Butter

- 2020 TCM levels in butter averaged 0.021 mg/kg
- **Chlorine free cleaning protocols introduced**
- 2021 TCM levels averaged 0.015 mg/kg
- 2022 TCM levels averaged 0.017 mg/kg
- All annual average TCM values for milk and butter within target in 2021 and 2022 – ongoing monitoring important

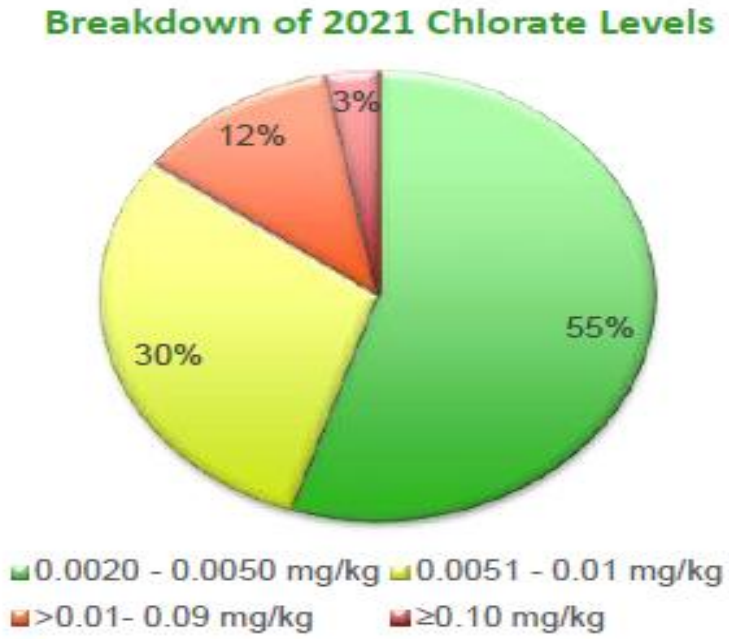
Chlorate in Bulk Milk

- Chlorate formed during storage of a chlorine product
- Influenced by: Chlorine %; Storage conditions; Duration
- Critical for milk powder; potential for development :
  - the milk production process on the farm
  - the conversion (drying) of milk to the powder ingredient at the processing plant
- Individual processors now measuring chlorate
- Initial examination of “chlorine free” cleaning protocols - in **March to November** of 2020 & 2021
- Samples sourced from those regularly submitted to Moorepark by 7 milk processors (for TCM analysis)
- ~ 2.5% of samples of each processor selected per month
- ~ 3,500 bulk milk samples analysed across 2020 & 2021

Percentage of samples with detected chlorate in 2021 - 7% less than in 2020

2021

In 2021 **8%** of samples analysed displayed detectable levels of chlorate (≥0.0020 mg/kg).



Key point

- **92% of samples had non - detectable levels, i.e. <0.002 mg/kg**

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Chlorate results

- Chlorate was not detected in 92% of samples with the “chlorine free” protocol in 2021
- Chlorate was detected (> 0.002 mg/kg) in 8%
- But: need to monitor change to ensure protection of markets and IF the MRL was reduced further
- Substantial work programme: processors incorporating chlorine gas systems and research focus on promoting “chorine free” protocols at farm level - funded by DAFM /FIRM measure and Dairy Levy Trust
- Next focus: to examine microbial trends – has the removal of chlorine had impact ?

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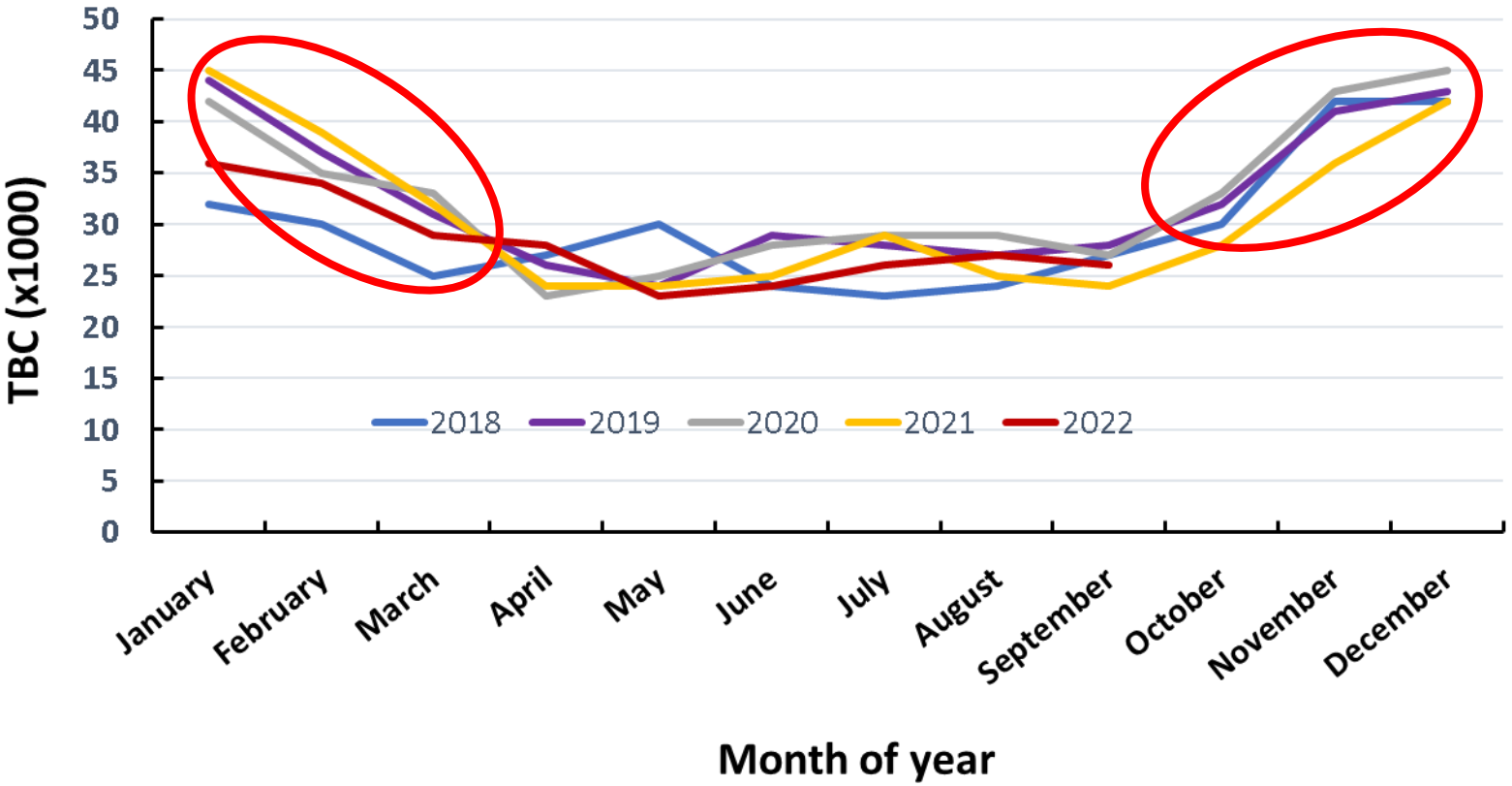
TBC levels in Processor 1 milk between 2018 and 2022



- No evidence of negative impact of chlorine free cleaning
- TBC between 23 and 30 x10^3 /ml April to October
- Relatively higher up to April and from October (30-45 x10^3 /ml)

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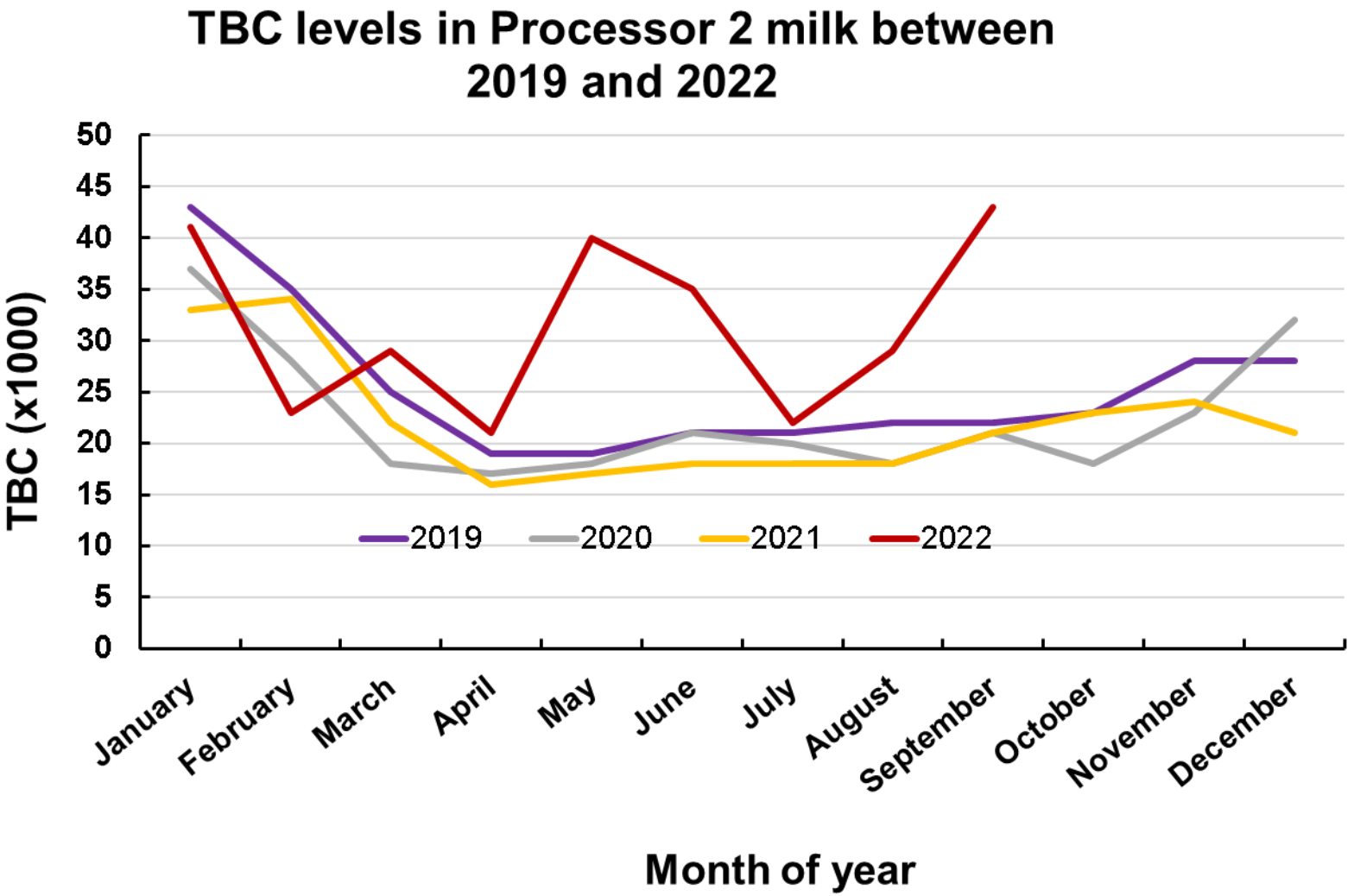

- Changeable TBC for 2022 - 4 points at 30 x10^3/ml or greater May to Sept
- TBC between 15 and 23 x10^3 /ml April to October
- Relatively higher TBC up to April (15-45 x10^3 /ml)

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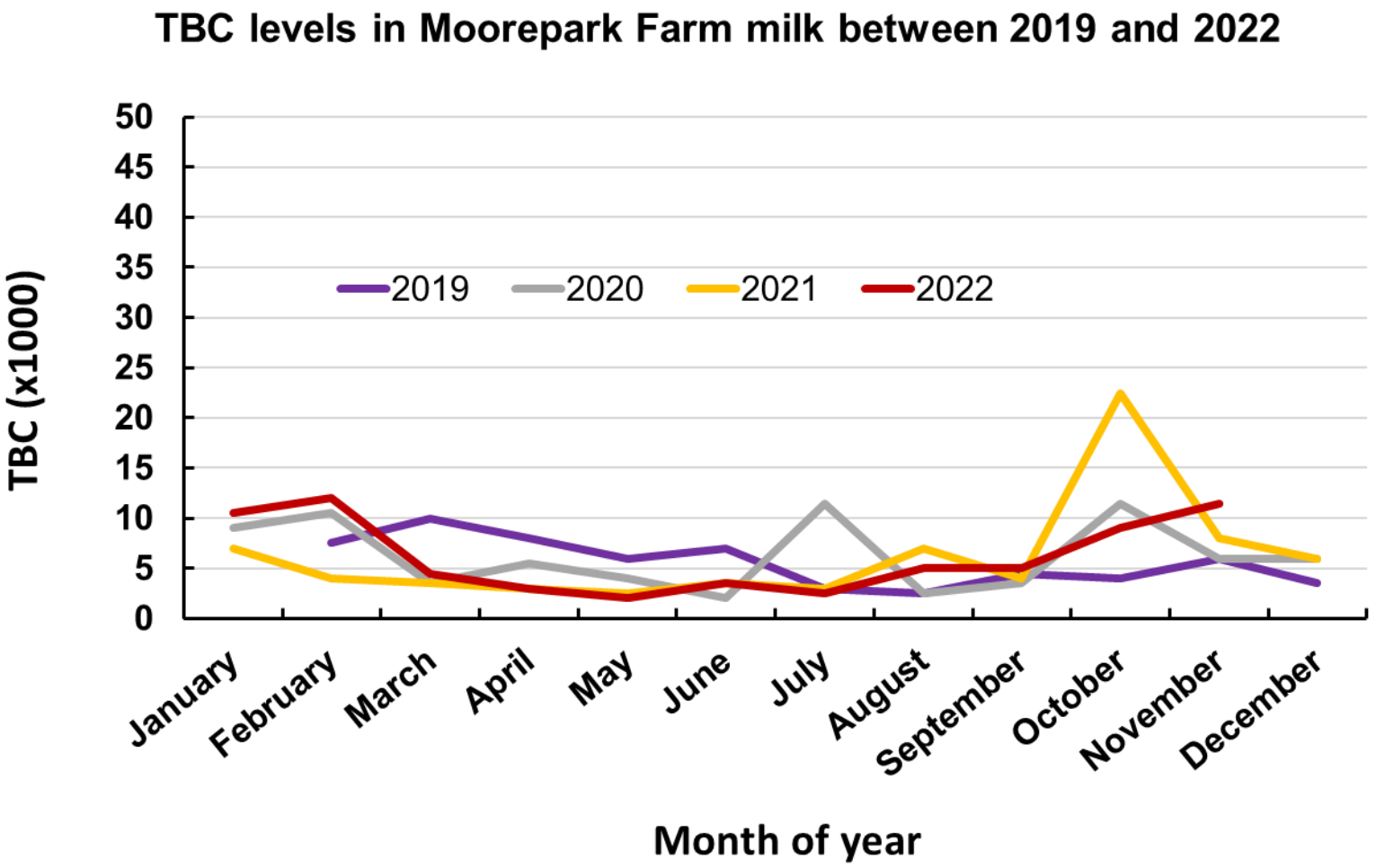

- **No evidence of negative impact of chlorine free cleaning**
- **Generally TBC between 3 and 12 x10^3 /ml throughout year (except 1 point)**

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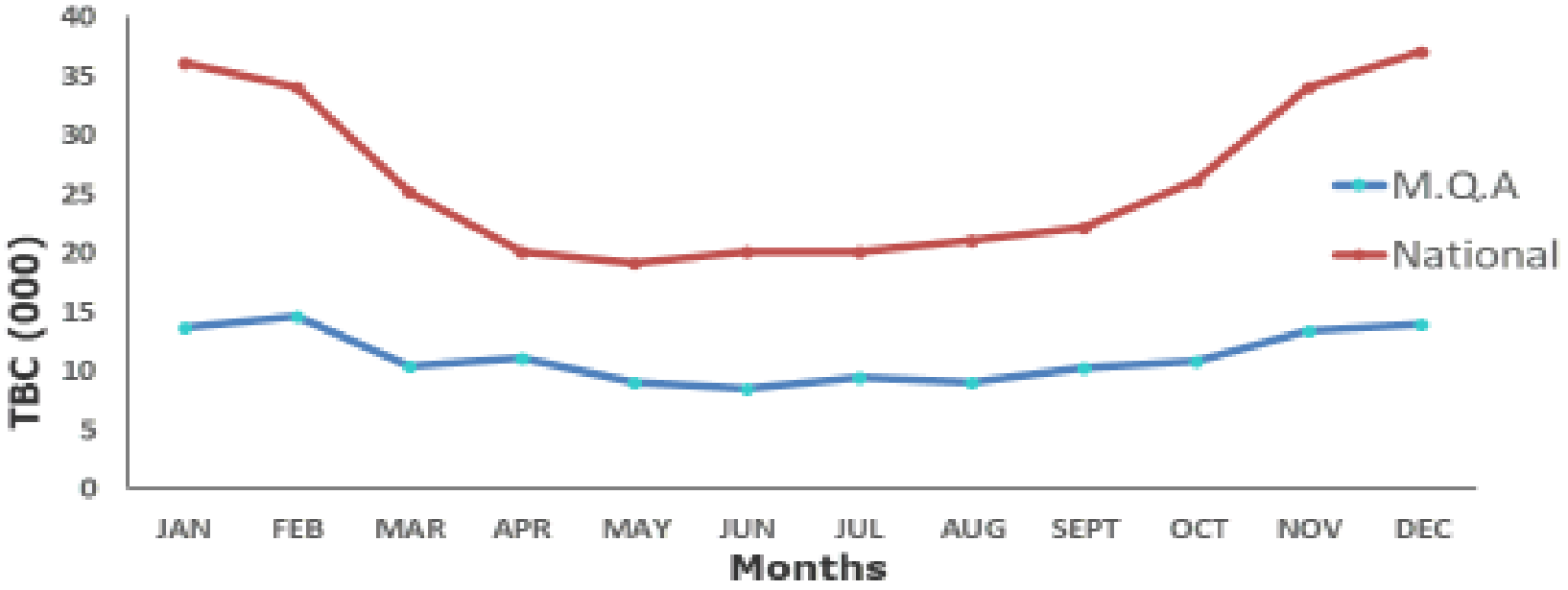
Average TBC levels in bulk milks of 8 processors and Milk Quality Award nominees over 8 years



- **TBC levels of bulk milks of processors very similar to Processor 1 milks above (TBC between 20 and 35 x10^3 /ml**
- **TBC levels of Milk Quality Award nominees similar to Moorepark milks above (TBC between 7 and 15 x10^3 /ml**

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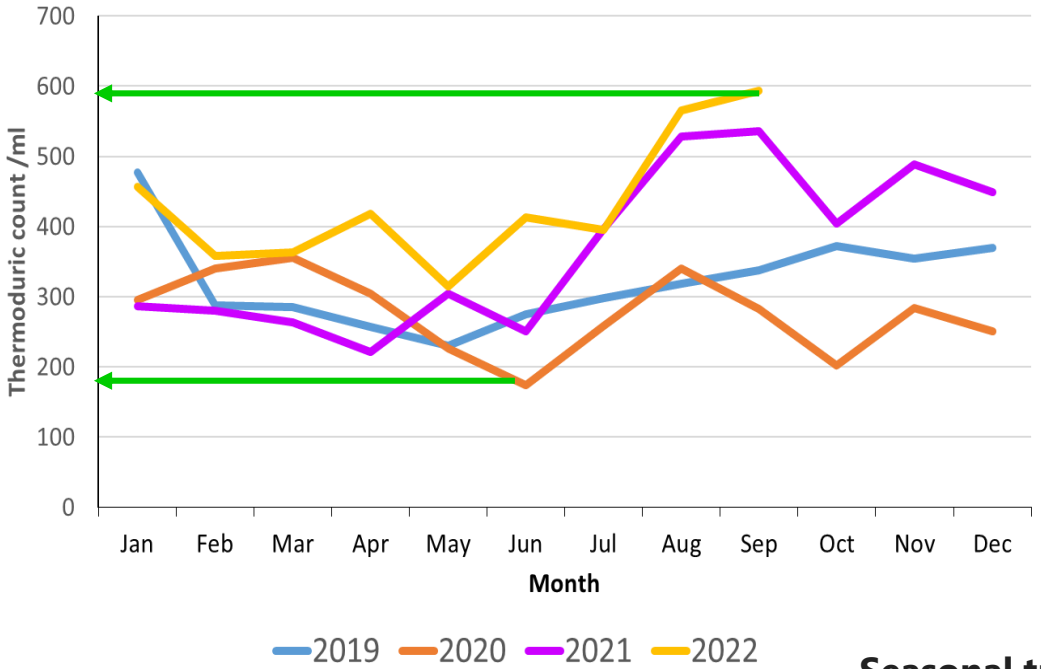
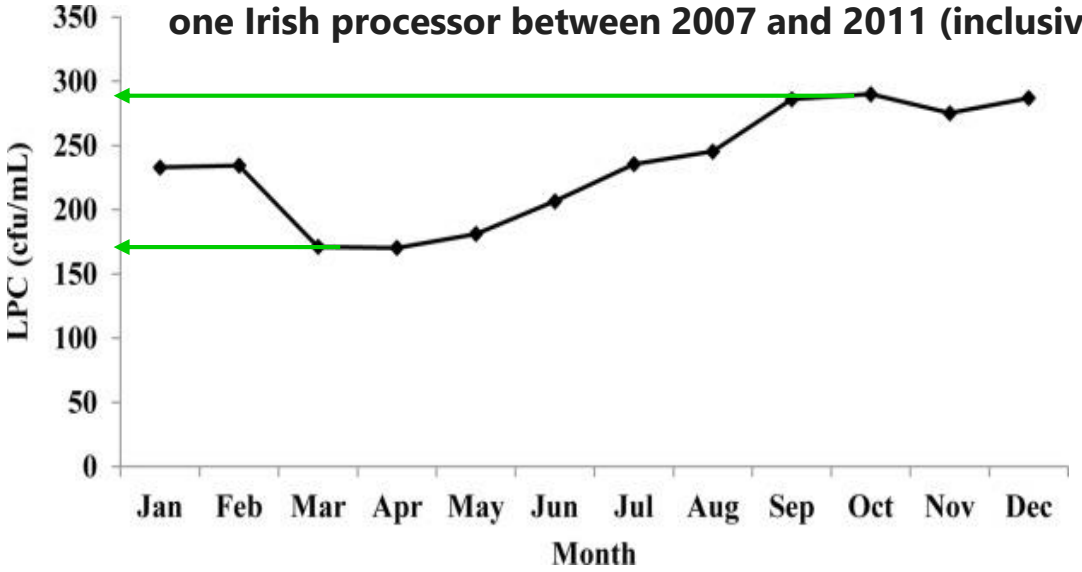
Seasonal variation in Thermoduric counts from 2019 to 2022



Seasonal trend in bulk tank thermoduric counts for one Irish processor between 2007 and 2011 (inclusive)



Microbial quality – effect of "chlorine free" cleaning protocol

- No evidence of negative impact of chlorine free cleaning for Processor 1 or Moorepark Farm milks
- Processor 2 – some deterioration in TBC for 2022
- All processor milks have higher TBC than Moorepark and Milk Quality Award nominees
  - Processor milks generally at 15-25-30 $x10^3$/ml during main lactation period and higher at shoulders
- Moorepark Farm bulk tank TBCs 3-12 $x10^3$/ml throughout year
- Milk Quality Award nominees TBC 7-15 $x10^3$/ml throughout year
- Some indication of Thermoduric bacteria increasing ?

Conclusions

- “Chlorine free” cleaning had a positive impact on TCM in milk and butter
- “Chlorine free” cleaning had a positive impact on chlorate in milk
- Average values of each parameter are within target levels
- But focus must be maintained – instances of ‘outside of target’ TCM and Chlorate levels
- Some evidence of increased thermoduric levels
- But TBC and thermoduric levels can be maintained very low when a “Chlorine free” cleaning protocol is applied correctly


Thank you