# A dietary sugarcane-derived polyphenol mix reduces enteric methane emissions and improves meat quality in pasture-fed beef cattle

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## I. INTRODUCTION

Strategies to use feed additives to reduce methane emissions and improve meat quality is a novel area of research as part of responsible meat production. Previous studies have demonstrated that plant-based polyphenols can reduce enteric methane emissions [1] and possess antioxidant capability to improve the shelf life of meat [2]. Recent research from our lab has demonstrated the anti-methanogenic potency of polyphenols in sheep [1], and heat stress mitigation with improved meat quality in chicken.[3]. The present study investigated the effects of sugarcane-derived polyphenol supplementation (SDP) on the enteric methane emissions and meat quality of pasture-fed beef cattle.

## II. MATERIALS AND METHODS

The animal study was approved by the University of Melbourne Animal Ethics Committee. Twenty-four Angus steers (avg age 6 months) were selected for 6 months study and randomly allocated to two groups (N=12) CON: Lucerne pellets, SDP: commercial sugarcane-derived polyphenol supplement incorporated into Lucerne pellets (@ 0.25%/Dry matter). Pellets were delivered using automatic feeders (Lely® Netherlands) placed in each paddock while animals were grazing perennial pastures. Enteric methane emissions were measured via Guardian NG gas cards installed on the automatic feeder. Body weights were recorded every month over 6-month study period starting with weaners (approx. 220±20 kg). At the end of the grazing and supplementation study, steers were slaughtered at a commercial abattoir, and carcass quality and MSA data were recorded. Ultimate pH was measured and M. longissimus lumborum (LL) and M. psoas major (PM) from the left side of the carcasses were collected 24 hrs postmortem. For retail color stability, each muscle was cut into pieces with an average weight of 120±10 grams packed in aerobic packaging and placed in a 4-6 ºC refrigerator cabinet with LED internal lighting to simulate the retail display conditions. Meat color (L*, a*, b*) was measured each day using a Minolta colorimeter. Drip loss was measured at day 0 by the EZ-drip loss method, purge loss was measured between days 0 and 1,3,5, and 7. Cooking loss and Warner-Bratzler Shear Force (WBSF) were measured on days 0,1,3,5 & 7 using a texture analyzer. Lipid oxidation was assessed for all days by TBARS procedure as described by Sørensen and Jørgensen [4]. Statistical analysis was performed using Genstat (22nd edition) by the method of restricted maximum likelihood (REML) based on multiple factors (pellets fed, muscles, display days). Multiple comparisons were conducted using Tukey's test.

## III. RESULTS AND DISCUSSION

The effect of feeding of SDP was highly significant ($p<0.001$) in reducing total methane production without any adverse impact on growth rate and carcass characteristics. There was a significant ($p<0.001$) effect of dietary treatment on meat lipid oxidation and lower TBARS values were observed in the meat of animals fed lucerne pellets with SDP as compared to the CON group (Table 1). In CON, the malonaldehyde (MDA) value in LL was lower on day 1 and then increased between days 3, 5, and 7. Dietary treatment had a significant effect on cooking loss, and meat of animals fed lucerne pellets with

SDP showed lower cooking loss. Purge loss was also significant, and the SDP group had lower purge loss throughout the display for both LL and PM. Warner-Bratzler Shear Force values were higher for LL in the SDP treatment group while lower for PM in comparison with CON and interaction between day and treatment was significant ($p$<0.05).

Table 1- Mean (SED & P Values) Lipid oxidation, WBSF, Cooking Loss, and Purge Loss of beef muscles during retail display.

| | | | Days | | | | | p-Values | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **T** | **M** | **0** | **1** | **3** | **5** | **7** | **SED** | **Days** | **M** | **T** | **D*M** | **D*T** | **M*T** | **D*M*T** |
| **Lipid Oxidation (MDA/kg)** | **CON** | **LL** | 0.178 | 0.210 | 0.562 | 0.622 | 0.884 | 0.060 | <0.001 | 0.038 | <0.001 | 0.001 | <0.001 | 0.905 | 0.775 |
| | | **PM** | 0.140 | 0.284 | 0.531 | 0.677 | 1.032 | | | | | | | | |
| | **SDP** | **LL** | 0.237 | 0.360 | 0.493 | 0.592 | 0.441 | | | | | | | | |
| | | **PM** | 0.147 | 0.515 | 0.477 | 0.589 | 0.579 | | | | | | | | |
| **WBSF (N)** | **CON** | **LL** | 30.57 | 26.5 | 19.4 | 21.18 | 16.43 | 1.374 | <0.001 | <0.001 | 0.22 | <0.001 | 0.043 | 0.002 | 0.171 |
| | | **PM** | 24.03 | 22.3 | 21.1 | 21.86 | 18.55 | | | | | | | | |
| | **SDP** | **LL** | 33.59 | 31.22 | 21.52 | 18.56 | 20.38 | | | | | | | | |
| | | **PM** | 23.09 | 21.88 | 19.99 | 20.56 | 20.02 | | | | | | | | |
| **Cooking Loss (%)** | **CON** | **LL** | 21.56 | 28.21 | 20.85 | 26.11 | 22.43 | 0.917 | <0.001 | 0.527 | <0.001 | 0.009 | 0.086 | 0.323 | 0.092 |
| | | **PM** | 22.19 | 27.36 | 22.99 | 24.63 | 21.34 | | | | | | | | |
| | **SDP** | **LL** | 18.25 | 25.71 | 20.16 | 24.01 | 21.8 | | | | | | | | |
| | | **PM** | 21.38 | 25.28 | 19.87 | 23.56 | 22.06 | | | | | | | | |
| **Purge Loss (%)** | **CON** | **LL** | ------ | 1.248 | 0.698 | 1.188 | 1.789 | 0.2815 | <0.001 | 0.351 | 0.007 | 0.432 | 0.014 | 0.129 | 0.631 |
| | | **PM** | ------ | 1.332 | 0.694 | 1.868 | 2.062 | | | | | | | | |
| | **SDP** | **LL** | ------ | 0.707 | 0.627 | 1.738 | 1.368 | | | | | | | | |
| | | **PM** | ------ | 0.493 | 0.513 | 1.684 | 1.568 | | | | | | | | |

SED: Standard Error of Difference
T: Treatment
M: Muscle
D*M: Day x Muscle
D*T: Day x Treatment
M*T: Muscle X Treatment
D*M*T: Day x Muscle x Treatment

## IV. CONCLUSION

This study has shown that dietary sugarcane-derived polyphenol supplementation reduces enteric methane emissions and improves the meat quality characteristics such as lower cooking loss, purge loss, and lipid oxidation while enhancing retail shelf life. Consequently, it can be suggested that sugarcane-derived polyphenol is a suitable feed additive for mitigating GHG emissions and enhancing meat quality in grazing beef cattle.

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