Agricultural Products from Steam Distilled Grape Marc

Tarac Technologies was established in 1930 by ex-CSIRO scientist Alfred Allen at his home in the heartland of the Australian Wine Industry – the Barossa Valley, South Australia. Today Tarac treats over 120,000 tonnes of fresh grape marc, more than 40 million litres of liquid waste and approximately 7,000 tonnes of solid waste from the wine industry annually.

In addition to providing these key environmental solutions, along with a number of valued products to the wine industry, Tarac delivers stockfeed options to the agricultural industry in the form of grape derived products, namely Crimped Marc, Steam Distilled Grape Marc and Meal.

These products are created from grape marc which has been through a steam distillation process. The steam distillation process ensures alcohol is removed from the fresh marc, it also greatly reduces the risk of residual vineyard sprays being passed on to the animal and in turn to the milk/meat (refer Dairy Food Safety Victoria’s Notice to Dairy Farmers at Attachment 1).

The use of steam distilled grape marc is therefore of key importance when using grape marc as a stockfeed.

Crimped Marc
Crimped Marc is essentially screened and milled steam distilled grape marc. The importance of the crimping process in maximising feed value should not be underestimated. ‘Of grape seed that has been finely ground and fed in a total diet, fat was 100% digestible whereas the digestibility of fat is around 50% in the majority of feeding trials with fresh or dried ensiled grape marc.’¹

It is a high moisture silage type variant delivering improved nutritional benefits over Steam Distilled Grape Marc at cost competitive values on Dry Matter (DM) Basis against grains, high value hay and silages. Metabolisable Energy (ME) values improve from 6-7MJ/Kg to 10-11MJ/Kg. It has an average protein content of 12-13% and fat content of 8-10%.

Like any silage system best returns are realised when best practice methods of storage are used. Crimped marc stored in grain silo bags without the use of inoculants, maintained its integrity and feed values for 7 months.

Steam Distilled Grape Marc
Commonly known as ‘spent marc’, Steam Distilled Grape Marc is a palatable source of fibre and protein with nutritional values similar to pasture hay. It is used by cattle and sheep feedlots as a cost effective maintenance feed or combined with other ingredients to form a complete feedlot ration.

Originally Steam Distilled Grape Marc was used extensively in times of drought, however farmers quickly recognised the benefits of including it as a supplement feed throughout the year as part of their formulated ration. The product is available in bulk.

Meal
Meal, ground grape skins and seeds (best suited to compound feed millers), can be easily blended into existing rations and available for a larger range of animals. This product is available in bulk or 650kg bags.

Tarac has been collaborating with a number of research organisations on a variety of trials which have demonstrated the benefits of using these products, which include:

- Local, convenient & cost effective stockfeed options;

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• All are a good source of Omega 6 - beneficial for reproduction;
• Improves milk - positive influence on fatty acid profile;
• Aids in Methane reduction by up to 20% - improved production & lower environmental impact;
• Better beef – growth, improved feed intake and flavour;
• Sheep & lamb - improved meat production;
• Assists with ruminant health - bloat control, potential nematocides, shift in ammonia from urine to faeces;
• Efficiencies are gained by redirection of energy previously lost in methane production to produce milk, meat, wool & fibre.

Local, Convenient & Cost Effective
• Tarac Crimped Marc is a made to order product that has a longer, more flexible delivery timeframe in comparison to conventional silages, ie supply within 5-7 days of order.
• Tonnes supplied are not limited to the growing limitations in the paddock.
• Valuable time and costs associated with on farm silage production can be reattributed to other sectors of the business.
• Incorporating Tarac Crimped Marc into Supplementary feeding systems allows producers to take advantage of a local resource that has far less environmental impact than Palm Kernel Expeller (PKE) which is fully imported.
• Energy and protein costs delivered on farm are less using Crimped Marc (refer Table 1 below).

Table 1
<table>
<thead>
<tr>
<th></th>
<th>Feed Barley</th>
<th>Oaten Hay</th>
<th>Crimped Grape Marc</th>
<th>Spent Grape Marc</th>
</tr>
</thead>
<tbody>
<tr>
<td>On farm cost $/t</td>
<td>$250</td>
<td>$200</td>
<td>$100</td>
<td>$60</td>
</tr>
<tr>
<td>Dry matter %</td>
<td>90</td>
<td>90</td>
<td>50</td>
<td>50%</td>
</tr>
<tr>
<td>Energy MJ/kg DM</td>
<td>13</td>
<td>9.3</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Crude Protein % DM</td>
<td>11</td>
<td>5.8</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>$/t DM</td>
<td>$278</td>
<td>$222</td>
<td>$200</td>
<td>$120</td>
</tr>
<tr>
<td>$/t DM</td>
<td>$0.28</td>
<td>$0.22</td>
<td>$0.20</td>
<td>$0.12</td>
</tr>
<tr>
<td>MJ per tonne DM</td>
<td>13000</td>
<td>9300</td>
<td>11,000</td>
<td>6000</td>
</tr>
<tr>
<td>Cost cents MJ</td>
<td>2.14</td>
<td>2.39</td>
<td>1.82</td>
<td>2.0</td>
</tr>
<tr>
<td>MJ per $100</td>
<td>4680</td>
<td>4185</td>
<td>5500</td>
<td>5000</td>
</tr>
<tr>
<td>Cost $/Kg Protein</td>
<td>$2.53</td>
<td>$3.83</td>
<td>$1.67</td>
<td>$0.92</td>
</tr>
</tbody>
</table>

Allowing for a freight component of up to $60 t crimped marc is still competitive on protein & ME unit costs.

Omega 6 - Lipids & fats

Grape seed oil is approximately 70% Omega 6 – Linoleic Acid. The inclusion of Crimped Marc in rations is an easy way to provide a source of Omega 6 which cannot be made by the animal.

Omega fatty acids have been shown to influence the production of the hormone prostaglandin in the uterus. Synthesis of prostaglandin leads to the regression of the corpus luteum, the progesterone producing structure on the ovary. This will induce parturition and stimulate contraction of the uterus. Cows diagnosed without endometritis post-partum had a higher level of prostaglandin at calving compared to cows with endometritis, emphasising the positive role that prostaglandin plays during the peripartum period.

Omega 6- Linoleic Acid can be converted in the animal through enzymatic reactions into arachidonic acid, which is the precursor of prostaglandin. With the beneficial effects of prostaglandin on endometritis and retained placenta,

\[^{2}\text{Wolleswinkel, P., Abrahamse, S. Healthy Fatty Acids for Better Fertility in Cows, Feedmix Volume 16 Number 6 2008}\]
\[^{3}\text{Wolleswinkel, P., Abrahamse, S. Healthy Fatty Acids for Better Fertility in Cows, Feedmix Volume 16 Number 6 2008}\]
\[^{4}\text{Wolleswinkel, P., Abrahamse, S. Healthy Fatty Acids for Better Fertility in Cows, Feedmix Volume 16 Number 6 2008}\]
feeding Linoleic acid peripartum is thus expected to support the uterus around calving. This will in turn help improve the ability of the cow to conceive again.

**Milk**

As outlined by Dr Peter Moate in his paper ‘Grape Marc Reduces Emissions When Fed to Dairy Cows’, “Steam distilled grape marc contains a lot of unsaturated fatty acids, especially linoleic acid. By feeding grape marc to the cows we increased the concentration of unsaturated acid, polyunsaturated acid and reduced the concentrations of saturated acids in milk.”

There is considerable interest in altering fatty acid composition of milk to decrease the content of medium-chain saturated fatty acids and increase the concentrations of long chain bioactive lipids, including cis-9-18:1, trans-11-18:1 and cis9,trans11-18:2 is desirable.\(^5\)

**Pathways by which fatty acids derived from dietary oleic and linoleic acids can become available for milk fat production:**

**Rumen:**

Linoleic Acid cis-9-12 18:2 → Conjugated Linoleic Acid cis-9- trans 11 18:2 → Trans Vaccenic Acid trans-11 18:1 → Oleic Acid Cis-9 18:1

**Mammary Gland:**

Trans Vaccenic Acid trans-11 18:1 → (delta-9- desaturase) → Conjugated Linoleic Acid cis-0- trans-11 18:2

Steric Acid 18:1 → (delta-9- desaturase) → Oleic Acid cis-9 18:1

**Putative pathways of ruminal biohydrogenation of oleic, linoleic & linolenic acids.\(^6\)**

Oleic Acid cis9 18:1 → Linoleic Acid cis-0-cis12 18:2 → Linolenic Acid cis-9cis12-cis-15 18:3

Conjugated Linoleic Acid Cis-9-trans-11 18:2 → cis-9-trans-11- cis-15 18:3

Trans Vaccenic Acid Trans-11 18:1 → Trans-1 cis-15 18:2

Steric Acid 18:0 → trans-15 or cis-15 18:1

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Methane Reduction

A study, carried out at Department of Primary Industries Ellinbank, Victoria, whereby steam distilled grape marc was fed to dairy cows in late lactation, returned results showing a 20% reduction in methane output with a positive influence on the fatty acid profile of the milk.

The 32 cattle divided into three groups and fed different diets over 37 days. The first was a control group and each cow in this group was fed a diet containing crushed wheat grain and lucerne hay, while the second group was fed a diet containing crushed wheat grain, lucerne hay and 5kg of DM of pelleted dried steam distilled grape marc. The cows in the third group were fed the control diet and 5kg/DM of ensiled grape marc. The cattle were milked twice a day over the 37 day study period. (Refer table 2 below).

Table 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>Dry grape marc</th>
<th>Ensiled grape marc</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH4 (g/cow/day)</td>
<td>470 b</td>
<td>375 a</td>
<td>389 a</td>
</tr>
<tr>
<td>CH4 (g/kg DMI)</td>
<td>26.1 c</td>
<td>20.2 a</td>
<td>21.5 b</td>
</tr>
<tr>
<td>CH4 (g/L Milk)</td>
<td>35.3 b</td>
<td>26.1 a</td>
<td>35.2 b</td>
</tr>
<tr>
<td>Milk (L/d)</td>
<td>13.4 ab</td>
<td>15.0 b</td>
<td>11.5 a</td>
</tr>
</tbody>
</table>

"As well as substantially reducing emissions, it altered the fatty acid content of the milk".7

Reducing Methane has a twofold benefit:
- lower environmental impact; and
- further efficiencies are gained by the fact that some of the energy previously lost in methane production can instead be used by the animal to produce meat, milk, wool & fibre.

Beef

A 143 day Canadian trial using 69 Angus-Hereford X steers comparing a control feedlot diet with one containing 6-7% winery by-product (WB), consisting almost exclusively of wine lees except for one batch which contained improperly fermented wine.

The trial reported that: Meat quality attributes including chemical, colour and tenderness properties did not differ (P>0.05) between diets with the exception of ground steak, which was darker (P=0.0477) in cattle fed WB compared to C supplemented feeds, respectively. Supplementing cattle feeds with WB provides a new marketing stream for beef products with no observed differences to cattle behaviour, animal gains or meat tenderness.8

Growth

In a commercial study, 50 Aberdeen Angus and Aberdeen Angus - Hereford cross steers were ‘finished’ for 6 weeks in late winter on freshly ensiled grape marc supplementing conserved pasture and good quality meadow hay. Approximately 150kg per day of the supplement was fed (or about 3kg/animal).

The average daily live weight gain was 1.63kg, and dressing percentage was 55%. A single animal was selected to participate in a "Paddock to Plate" competition, with 41 other entries. It was judged 2nd on the hoof, 8th on the hook (prime cuts were judged to be "inconveniently large"!), 2nd on the plate and palate, and 2nd overall.9

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9 Rich Technology Solutions Ltd 2013 www.richtech.co.nz
Feed Intake

Study results (refer table 3 below), indicate that the inclusion of grape marc into a concentrate based diet increased the total feed intake of cattle. The numbers of animals removed from the study due to bloat or inappetite on the high grain diet was greater than the grape marc diets. This points to a major and important issue supporting the use of grape marc in grain based diets that it’s apparent ability to promote rumen conditions favourable for optimal fermentation. The mode of action most likely being the reduction in acidosis which is often a major problem in grain fed ruminants.10

The effects of replacing crushed barley with grape marc plus urea on the growth rate of Friesian calves over 210 days (initial live weight approx. 150kg) are also shown in Table 3. Diets were supplemented with dicalcium phosphate and a complete mineral mix.11

Table 3

<table>
<thead>
<tr>
<th></th>
<th>GMO</th>
<th>GM15</th>
<th>GM30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed intake [kg/day]</td>
<td>6.6</td>
<td>7.1</td>
<td>7.3</td>
</tr>
<tr>
<td>Weight gain [kg/day]</td>
<td>1.23</td>
<td>1.24</td>
<td>1.15</td>
</tr>
<tr>
<td>FCR [kg feed/ kg gain]</td>
<td>5.5</td>
<td>5.7</td>
<td>6.3</td>
</tr>
</tbody>
</table>

GMO—85% Crushed Barley, 13% cottonseed cake,  GM15—69% crushed barley, 13% cottonseed cake, 15% Dried grape marc, 0.6% urea  
GM30—53% crushed barley, 13% cottonseed cake, 30% grape marc, 1.2% urea

Fatty Acids and CLA

Essential fatty acids such as conjugated linoleic acid (CLA) and other polyunsaturated fatty acids (PUFAs) have been demonstrated to have anti-carcinogenic, antithrombogenic and antiatherogenic properties. PUFAs also exhibit antioxidative effects in meat products which may enhance colour and extend shelf life.

CLA is a fatty acid that decreases body fat and increases lean tissue. It has been demonstrated that feeding CLA to pigs decreases back fat by up to 25% and increases protein deposition have been reported.12 Raw materials in the diets of ruminants may have an influence on the fatty acid composition of fat and muscle tissue by both the amount and composition of lipids in each ingredient.13

Improved Flavour

A beef feedlot has been using Tarac steam distilled grape marc in their ration for a long term overseas customer marketing their product as ‘Wine Beef’.

Sheep

A research study conducted by The University of Adelaide Roseworthy Campus, found that the inclusion of Tarac Meal formulated into a pellet ration by a compound feed miller and fed to lambs for meat production, delivered strong growth and production results. At low inclusion rates bioequivalence was achieved and at up to 20% of the ration the control diet was outperformed (refer table 4 below).

10 Leng, R 2005 potential of grape marc as a feed resource for domesticated ruminants. Bionutric Pty Ltd
13 Bas, P. & Morand-Fehr, P. 200: Effect of nutritional; factors on fatty acid composition of lamb fat deposits. Livest. Prod. Sci. 64, 61-79
### Table 4

<table>
<thead>
<tr>
<th>Ingredient &amp; % moisture</th>
<th>CONTROL</th>
<th>5% Meal</th>
<th>10% Meal</th>
<th>15% Meal</th>
<th>20% Meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Used</td>
<td>Mix Kg</td>
<td>% Used</td>
<td>Mix Kg</td>
<td>% Used</td>
<td>Mix Kg</td>
</tr>
<tr>
<td>Peas-23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins-27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill Mix-15</td>
<td>40.000</td>
<td>400.000</td>
<td>35.000</td>
<td>350.000</td>
<td>35.000</td>
</tr>
<tr>
<td>Oat Offal-4</td>
<td>15.000</td>
<td>150.000</td>
<td>13.719</td>
<td>137.190</td>
<td>10.727</td>
</tr>
<tr>
<td>Canola Expeller 34</td>
<td>15.100</td>
<td>151.000</td>
<td>15.615</td>
<td>156.150</td>
<td>14.944</td>
</tr>
<tr>
<td>Grape Marc Meal 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bentonite</td>
<td>0.373</td>
<td>3.730</td>
<td>0.974</td>
<td>9.740</td>
<td>1.991</td>
</tr>
<tr>
<td>Acid Buf</td>
<td>0.890</td>
<td>8.900</td>
<td>0.884</td>
<td>8.840</td>
<td>0.878</td>
</tr>
<tr>
<td>Bovatec 20CC</td>
<td>0.500</td>
<td>5.000</td>
<td>0.500</td>
<td>5.000</td>
<td>0.500</td>
</tr>
<tr>
<td>Sheep 9924 v4</td>
<td>0.100</td>
<td>1.000</td>
<td>0.100</td>
<td>1.000</td>
<td>0.100</td>
</tr>
<tr>
<td>Gypsum (CaSO4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liveweight Gain (kg)</td>
<td>8.30 KG</td>
<td>9.10 KG</td>
<td>9.00KG</td>
<td>9.20 KG</td>
<td>10.00 KG</td>
</tr>
<tr>
<td>Liveweight Gain (%)</td>
<td>25.00%</td>
<td>29.00%</td>
<td>27.80%</td>
<td>27.70%</td>
<td>31.30%</td>
</tr>
</tbody>
</table>

### Wool Growth

The presence of condensed tannins (CT’s) in the diet of sheep may be expected to contribute to increased amino acid absorption and nitrogen retention. A 55 day feeding study carried out in New Zealand suggested that sheep showed improved reproduction and also increased wool production. A 55 day feeding study carried out in New Zealand suggested that sheep showed improved reproduction and also increased wool production. Analysis of plasma suggests that the effect was due to an increase in essential amino acids, particularly branched chain amino acids. A similar study carried out over two years under dryland farming conditions showed that such effects were greatest in years with exceptionally dry autumn periods.

A spin off benefit to supplementing sheep or cattle on lush pasture with grape marc may be a reduction in problems associated with high infestations of intestinal parasites. The CT’s in grape marc appear to have antihelminthic properties. Studies with sheep grazing leguminous crops rich in tannins as compared to those on legumes low in tannins had reduced levels of nematode infections. As indicated by the lower levels of parasite eggs in the faeces of the sheep consuming the tanniniferous forage.

### Ruminant Health

Excerpts from Meat & Livestock Australia final report: “Natural bioactive compounds for livestock health and production”

### Feed intake and Behaviour

Feed intake and animal-feeding behaviour is governed by many factors including availability, palatability and feedback mechanisms. CT’s may be beneficial in the diet but at certain levels begin to affect feed intake. This level varies considerably, depending on the chemical nature of tannin and the animal species studied. Deer saliva has tannin-

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15 Ramirez-Restrepo, C.A., & Barry, T.N., Lopez-Villalobos, N, Kemp, N and Harvey, T.G. 2005b use of lotus corniculatus containing condensed tannins to increase reproductive efficiency in ewes under commercial dryland farming conditions. Animal Feed Science and Technology, 121, 23-43
binding proteins that are not found in sheep. The two animals also metabolise tannins of different structure classes in a different manner. In both deer and sheep, hydrolysable tannin is broken down shortly after consumption and there are no diminished protein absorption effects. However CT’s are recovered almost entirely from deer faeces, but only 60% is recovered from sheep faeces, suggesting some absorption. CT’s present in a number of plant species (including grape marc) may inhibit the activity of ruminal microorganism.

Growth and Carcass Composition
Nutritional studies on animal growth have often centred on an understanding of macronutrients, however it is becoming apparent that plant bioactives effect not only animal growth but also carcass composition. In meat animals this has significant implications for consumer acceptance. Grape marc is a natural feed additive that can provide conjugated linoleic acid which can improve the fat:lean ratio in some circumstances.¹⁸

Foam Production/ Bloat Control
Pasture bloat is a costly disorder, particularly for cattle grazing on high protein improved pastures. Proanthocyanidins as present in grape marc have been demonstrated to reduce foam production in vitro in a dose dependent manner.¹⁹ For animals such as dairy cattle the additional potential benefit of reduced risk of bloat should be considered.

Nematodes
The action of secondary metabolites as antinematodals has been the subject of recent reviews exploring both in vitro and in vivo effects of plant constituents.¹⁰ Lipids, phenolics (including CTs), alkaloids and terpenes have all been identified as nematocides. In the case of the simple fatty acids the presence of the acid moiety seems to be important.

Ammonia
Shifting the excretion pattern of nitrogen from urine to faeces and formation of CT-protein complex are beneficial environmentally. Faecal nitrogen is mainly in the organic form which is less volatile, whereas urinary nitrogen is largely in the form of urea, which is more rapidly hydrolysed to ammonia and nitrified to nitrate.²¹ CT-protein complex in faeces dissociates slowly in the soil because mineralisation of the complex is inhibited, and the faeces decompose more slowly compared to faeces without CT. Therefore decreased nitrogen excretion in the urine could reduce ammonia and nitrous oxide emissions into the atmosphere.²²

For more information please contact:
Brenton Mengersen
Sales Representative Agriculture

Disclaimer:
It is recommended that you seek independent nutritional advice regarding incorporation of the discussed products into your production system. Whilst Tarac Technologies Pty Ltd strives to ensure that the information contained in this document is accurate and reliable, Tarac Technologies Pty Ltd makes no warranties or representations as to the accuracy, correctness, reliability or otherwise with respect to such information, and assumes no liability or responsibility for any omissions.

Grape Marc as a Source of Stock Feed

Notice to Dairy Farmers

Grape marc can be used as a valuable source of supplementary nutrition for dairy cows. However it doesn’t come without risks, and these risks need to be well understood and managed.

As a by-product of the wine industry, grape marc, made up of skins and seeds may contain residues of agricultural chemicals. This is due to the use of sprays in the vineyards to control pests and fungal diseases on the grapes. The feeding of contaminated grape marc to dairy cows in turn presents a risk of the residues being transferred into the milk (and meat) supply.

Raw or unprocessed grape marc is considered to present a particularly high residue risk. Grape marc supplied through reputable feed companies will be processed using steam distillation which not only removes excess alcohol and tartaric acid, but is known to reduce (but not remove) the concentration of chemical residues in the grape marc.

In addition these feed companies regularly test the grape marc for chemical residues to ensure the product they are selling as stock feed is ‘fit for purpose’. These testing programs underpin the validity of the vendor declarations supplied to purchasers when buying consignments of grape marc.

As with all sources of purchased stock feed, dairy farmers need to continue to seek assurances regarding the suitability of feeds before committing them into the ration. Obtaining vendor declarations, is the way to do this.

If the chemical residue status of a feed cannot be determined and/or a commodity vendor declaration cannot be obtained, the best practice is to avoid using it as stock feed.

If you have any questions on the suitability and use of Grape marc as a stock feed, please contact your local Field Service Officer, or:

Corrie Goodwin – Dairy Food Safety Victoria (03) 9810 5900
Karen Armitage – Dairy Australia (03) 9694 3777

This statement discusses potential residue risks associated with the use of grape marc as a stock feed, and is not intended to make representation regarding the residue status of dairy products manufactured by individual dairy companies in Australia.

March 2010