Sorghum
an Alternative for Feeding Dairy and Beef Cattle.

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- BSc Tropical Animal Production – Deventer, The Netherlands
- King Ranch – Venezuela 1985
- MSc Range Nutrition 1990 – Texas A&M University
- PhD Animal Nutrition 1993 – Texas A&M University
- Nutritionist Kruse Grain & Milling, CA 1993-1995
- Independent Consultant to Dairy Industry 1995-2005
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TX, NM and AZ – 3rd largest milkshed!
(milk production in millions of lbs)

- #1 California: 39,512
- #2 Wisconsin: 25,239
- New Mexico, Texas and Arizona: 20,820
- #3 New York: 12,424
- #4 Idaho: 12,150
- #5 Pennsylvania: 10,551
- #6 Minnesota: 9,019
- #7 Texas: 8,840
- #8 Michigan: 7,968
- #9 New Mexico: 7,904
- #10 Washington: 5,561
- #13 Arizona: 4,076

Texas, New Mexico and Arizona combined: #3 nationally!

Source: February 2010 Milk Production Report, USDA
U.S. Top 5 – Average cows per herd

1. New Mexico 2,167
2. Arizona 1,609
3. California 987
4. Colorado 946
5. Idaho 917

Average herd size in US: 167

Wisconsin 95
New York 113
Pennsylvania 74

Source: February 2010 Milk Production Report, USDA
U.S. Top 5 – Milk per Cow

• 1. New Mexico 24,320
• 2. Washington 23,171
• 3. Colorado 23,089
• 4. Arizona 23,028
• 5. Michigan 22,445

• Average US milk per Cow: 20,567

• Arkansas 12,615
• Louisiana 11,870

Source: February 2010 Milk Production Report, USDA
Eastern New Mexico/West Texas Dairy Industry

- **Approximate Size:**
  - 2300 cows/operation
  - 400,000 cows
  - 174 producers
  - 8 billion lbs of milk
  - 4.4% of US milk
  - 75% of NM milk
  - 47% of TX milk
Where are we?

Depends on where we were...

.... and where we’re going
... or maybe its time to think a little outside the box...
“If the facts don’t fit the theory, change the facts.”

Albert Einstein
Feed grains:

• Corn, wheat sorghum and barley are all sources of energy for ruminants.
• They are the main sources of energy in ruminant rations.
• They can make up to 95% of the total ration for feedlot animals.
• Typically corn is the grain of choice and the others are considered secondary sources of energy.
• However this does not mean that any of these sources are inferior to corn, but more so a preference or maybe a habit of nutritionists to look at corn first.
Sorghum

• Sorghum is probably the most efficient feedgrain in terms of conversion of solar energy and water to feed energy.
• This fact is becoming increasingly more important in times of considering footprints (water, carbon, land and energy).
• Sorghum can be used in beef and dairy rations as a replacement for corn.
• Research has shown that sorghum is comparable to corn in beef and dairy
CRUDE PROTEIN VALUES IN FEED GRAINS USED IN RUMINANT DIETS

Source: Beef NRC (1996); Dairy NRC (2001)
PROTEIN

• Sorghum: higher CP value than corn, but lower than wheat or barley.

• You can expect sorghum to expect about 14% more CP than corn

• NRC values reflect a 23-28% higher value, however recent changes in plant genetics probably have given a dilution of CP into the increased starch values.
ACID DETERGENT FIBER (ADF) VALUES IN FEED GRAINS USED IN RUMINANT DIETS

Source: Beef NRC (1996); Dairy NRC (2001)
ACID DETERGENT FIBER (ADF)

• Lowest for corn and wheat and higher for sorghum and barley.

• These values for sorghum are likely due to a higher proportion of seed hull vs seed content.

• Yes there are differences, but they are small and especially in ruminants very limited.

• Balance for higher CP and less NE, and you’re good to go!
ENERGY VALUES FOR MAINTENANCE (NE\text{m}) VALUES IN FEED GRAINS USED IN RUMINANT DIETS

Source: Beef NRC (1996); Dairy NRC (2001)
ENERGY VALUES FOR GROWTH AND (NEg) LACTATION (NEI) IN FEED GRAINS USED IN RUMINANT DIETS

Source: Beef NRC (1996); Dairy NRC (2001)
SORGHUM AND CORN ARE VERY COMPARABLE IN TERMS OF ENERGY

• Energy terms for maintenance (NE_m), gain (NE_g) and lactation (NE_l), primarily reflect the efficiency with which an animal utilizes energy provided by the ration.

• There is a slight advantage for corn over sorghum but the difference in terms of performance is relatively low.

• If adjusted for the actual values (NE vs CP) performance will not be affected.
STARCH UTILIZATION IN RUMINANTS

- Starch is the principal source of energy in ruminant diets with high production potential.
- Ruminal starch fermentation patterns differ between the different feed grains.
- Ruminal starch utilization is a key determinant in improving the efficiency of utilization of feed grains in order to impact beef and dairy production, and to prevent the negative effects from ruminal acidosis from occurring.
- Sorghum ferments slower than other grains due to a more resistant starch-protein matrix and subsequent penetration of enzymes into that matrix as compared to corn and other feed grains (Theurer, 1986; Herrera-Saldaña et al., 1990).
STARCH UTILIZATION IN RUMINANTS

• In many cases a mix of feed grains can optimize a fermentation pattern compared to a single feed grain.

• It provides a higher level of stability of starch utilization in the rumen between feedings.

• This at the end improves the efficiency of production, but definitely improves rumen health and ultimately animal health and longevity.
RATE OF *IN SITU* STARCH DEGRADATION OF FEED GRAINS USED IN RUMINANT DIETS

Sorghum grain has to be processed in order to alter the protein matrix surrounding the starch granules and thereby improve their digestibility.

The standard processing methods are grinding, milling and steam flaking.

The size of the particles is very important in sorghum and finer grinding as compared to corn is needed to obtain similar feeding values (<100 microns).

There is substantial research that supports this recommendation, Mitzner et al. (1994) Titgemeyer y Shirley (1997).
• The major alteration of the protein matrix and the starch granules is achieved through steam flaking versus other methods.

• A combination of humidity, pressure and heat produces an effect making a major portion of the starch being available to the rumen microbes.

• Steam flaking can increase the energy value of sorghum with about 20%.

• This claim is substantiated by about 19 lactation trials as compared to other processing methods.
PROCESAMIENTO DEL GRANO DE SORGO

Bacterial Enzymes

Protein

Processed Sorghum

Starch

Available

Bacterial Enzymes

Processing
EFFECTS OF THERMAL PROCESSING ON INTAKE, TOTAL TRACK DIGESTION MILK PRODUCTION AND COMPOSITION

* Resultados de 6 estudios ** Resultados de 24 estudios
UTILIZATION OF SORGHUM IN LACTATING DIETS
UTILIZATION OF SORHUM IN LACTATING DIETS

• Grain sorghum can be an efficient source of starch for dairy cattle.

• Sorghum contains more CP than corn.

• Every lb of sorghum provides 0.013 lbs more protein than corn.

• If you feed 12 lbs of grain/day this equates 0.15 lbs more protein which can replace roughly 0.3 lbs of SBM.

• The quality of the amino acids is not as important in ruminants because of the conversion of plant protein to microbial protein.

• The main advantage is the possibility to reduce the level of protein supplement when replacing corn with sorghum.

• There is a substantial body of data backing this substitution of corn with sorghum in lactating diets without losing either milk production or milk composition.
SORGHUM FORAGE

• Sorghum can also be cultivated as a forrage source either as a complete silage or for roughage after the grain removal.
• The advantage is that the growing season is much shorter, has high biomass production and needs less resources.
• The sorghum silage is an excellent source of forrage in ruminant diets, lactating, dry and heifer rations.
• Generally corn silage contains higher level of digestible nutrients but the «brown rib» sorghum breeds have a higher level of dNDF.
• Recent studies confirm that similar milk production can be obtained with brown rib sorghums as compared to corn silage (Aydin et al., 1999; Oliver et al., 2004).
• Dann et al. (2007) reported similar milk solids when feeding sudán-sorghum brownrib silage as compared to corn silage.
UTILIZATION OF SORGHUM IN BEEF CATTLE
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Consumo de materia seca*, ganancia diaria de peso y eficiencia alimenticia* en granos utilizados en alimentación de ganado de engorda

<table>
<thead>
<tr>
<th></th>
<th>Ganancia Diaria Peso (lb/d)</th>
<th>Consumo MS (lb/d)</th>
<th>Eficiencia alimenticia (lb/lb)</th>
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<tr>
<td>CEBADA</td>
<td>3.13</td>
<td>19.34</td>
<td>6.24</td>
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<tr>
<td>MAIZ</td>
<td>3.15</td>
<td>16.69</td>
<td>6.32</td>
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<tr>
<td>SORGO</td>
<td>3.06</td>
<td>20.79</td>
<td>6.88</td>
</tr>
<tr>
<td>AVENA</td>
<td>3.31</td>
<td>20.18</td>
<td>6.12</td>
</tr>
<tr>
<td>TRIGO</td>
<td>3.04</td>
<td>19.07</td>
<td>6.34</td>
</tr>
</tbody>
</table>

* Se presentaron diferencias estadísticas p<0.05 entre los tipos de granos

Ganancia diaria de peso (GDP), consumo de materia seca (CMS) y eficiencia alimenticia (E.A.) de ganado de carne alimentados con maíz o sorgo procesados por diferentes métodos.

CONCLUSIONS

• Sorghum grain as well as forrage is an important feed source for both beef and dairy cattle

• Sorghum contains more protein than corn, but the ADF is higher which does not have to have a large effect on digestion in ruminants. Sorghum and corn are fairly comparable in terms of energy.

• Sorghum ferments slower in the rumen than other grains including corn, which is very important in rations of high producing dairy cows which need high levels of soluble carbohydrates as their prime source of energy.

• Processing is very important to maximize the efficiency of use of sorghum grain, and steam flaking has shown to be able to increase that value with about 20%.

• Utilization of grain sorghum in dairy and beef cattle rations has proven to give similar results than corn, and there are many research publications that show this effect.
REFERENCES


Sorghum in Dairy Production Feeding Guide. United Sorghum Checkoff Program. www.sorghumcheckoff.com


Thank You
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