Comparison of triticale cultivars with maize grain for finishing lambs

T.S. Brand*
Elsenburg Agricultural Development Institute, Private Bag X1, Elsenburg, 7607 Republic of South Africa

G.D. van der Merwe
Outeniqua Agricultural Development Centre, P. 0. Box 249, George, 6530 Republic of South Africa

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Grains from five triticale cultivars on the South African market (Usgen 7; 10; 14; 18; 19) were compared with each other and to maize in enriched mixtures for lambs in a feedlot. The grain was enriched by adding 12% of a commercial concentrate formula. Diets were fed individually to SA Mutton Merino lambs (5 ram and 5 ewe lambs/diet) from about eight weeks of age (*c.* 19 kg) to 20 weeks of age (*c.* 35 kg). Lucerne hay (milled through a 12- mm screen) was supplied separately at *c.* 10% of *ad libitum* intake. The crude protein (CP) content of triticale grain varied between 10.3% (Usgen 18) and 11.6% (Usgen 14). The mean *in vitro* organic matter digestibility (IVOMD; 88.8%), acid detergent fibre (ADF; 3.7%) and neutral detergent fibre (NDF; 20.4%) matched those in cited literature. The CP and digestible energy (DE) of the diets were 14.7% CP and 15.4 MJ DE/kg DM. No significant ($P > 0.05$) differences were observed between the diets in grain intake, hay intake, total dry matter intake, average daily grain (ADG) or feed conversion ratio (FCR). Lambs receiving enriched maize, however, tended to have better FCR (13%) than lambs consuming enriched triticale. Lambs fed Usgen 10 tended to have lower ADG (24%) and poorer FCR (22%) than lambs receiving the other triticale cultivars. Ram lambs had an 8% ($P \leq 0.08$) higher DMI and 19% ($P \leq 0.01$) faster growth than ewe lambs; their FCR was 9% ($P \leq 0.12$) better. Triticale may be fed successfully in enriched whole grain mixtures for feedlot lambs, although their FCR may be lower than with maize. Feeding values of triticale diets based on FCR ranged from 65% to 94% of that of maize diets, which averaged only 85%.

Die studie is uitgevoer om die vyf plaaslik beskikbare triticale-kultivars (Usgen 7; 10; 14; 18; 19) teenoor mekaar en met mielies, in graanverrykingsmengsels vir lammers onder voerkraaltoestande te vergelyk. Die graan is met 'n kommersiële mengsel vergelyk en aan SA Vleismerino-lammers (5 ram- en 5 ooilammers/dieet) van agt weke-ouderdom (*c.* 19 kg) tot 20 weke-ouderdom (*c.* 35 kg) gevoer. Lusernhooi (gemaal met 'n 12 mm-sif) is teen 10% van *ad libitum*-inname voorsien. Die ruproteïen (TRP)-inhoud van triticale het van 10.3% (Usgen 18) tot 11.6% (Usgen 14) gewissel. Die gemiddelde *in vitro* organiese materiaal verteerbaarheid (IVOMV; 88.8%), suurbestande vesel (SBV; 3.7%) en neutraal bestande vesel (NBV; 20.4%) was in ooreenkoms met literatuurwaardes. Die TRP- en verteerbare energie (VE)-inhoud van die diëte was 14.7% TRP en 15.4 MJ VE/kg DM. Geen betekenisvolle ($P > 0.05$) verskille tussen diëte in terme van inname, gemiddelde daaglikse toename (GDT) en voeromsettingsdoeltreffendheid (VOD) het tussen diëte voorgekom nie. Lammers wat verrykte mielies ontvang het, het egter 'n beter VOD (13%) as die lammers op die triticale-diëte gehad. Lammers op die Usgen 10-dieet het 'n laer GDT (24%) en swakker VOD (22%) as lammers op die ander triticale-diëte gehad. Ramlammers het hoër innames (5%; $P \leq 0.08$), hoër groeitempos (19%; $P \leq 0.01$) en beter VOD (9%; $P \leq 0.12$) as ooilammers gehad. Die studie het getoon dat triticale suksesvol in verrykte heelgraandiëte vir lammers onder voerkraaltoestande gebruik kan word, alhoewel 'n laer VOD as met mielies verwag kan word. Die relatiewe voedingswaarde van die triticale-diëte, gebaseer op VOD, was 85% van mielie-diëte (variasie tussen 65% en 94%).

Keywords: Finishing, grain, lambs, maize, triticale.

* To whom correspondence should be addressed.

Triticale, a cross between wheat (*Triticum aestivum*) and rye (*Secale cereale*), has become an important grain crop in the winter rainfall area of South Africa. It is produced mainly on marginal soil. Triticale has a higher yield than wheat on such soil, and currently, it is cultivated on about 35 000 ha of land in the winter rainfall region (H.S. Roux, Department of Genetics, University of Stellenbosch, Stellenbosch 7600; pers. comm.). The grain is mainly used as a feed.

The feeding value of triticale grain has been reported to be about average of that of wheat and rye. It is characterized by a low crude fibre content (2%), a high energy content (13.8 MJ metabolizable energy/kg DM) and a crude protein (CP) content of 12 – 16% (Todorov, 1988). A number of anti-nutritional substances occur in triticale. These include trypsin inhibitors, 5-alkylresorcinol and tannins (Evans, 1985). Although tannin levels are generally low and therefore unlikely to cause any growth depression (Evans, 1985), alkylresorcinol was found to be detrimental to animals (Sedlet *et al.*, 1984). Verdeal & Lorenz (1977) found that of wheat, rye and triticale, rye contained the highest and wheat the lowest amounts of alkylresorcinol, with triticale being inbetween. Trypsin inhibitors were found in some Australian triticale lines at levels similar to those in rye (Radcliffe, 1980). Another factor that may limit the use of triticale is contamination with ergot (Shimada *et al.*, 1974). Rye is high in pentosans (Todorov, 1988), which is known to interfere with nutrient intake and utilization by non-ruminants (Antoniou & Marquarot, 1981). These compounds may also occur in triticale.

Variable results have been reported with triticale as a feed grain. Brand & Cloete (1990) found that feedlot performance by lambs receiving enriched triticale was comparable with that of lambs fed enriched maize. Radcliffe *et al.* (1983) and Rao *et al.* (1980) also found that triticale was similar in feeding value to wheat or maize. McCloy *et al.* (1971) and Reddy *et al.* (1975), on the other hand, reported that triticale depressed animal performance. Results obtained by sheep producers in the winter rainfall region when using triticale-based diets have been inconsistent.

Due to the presence of anti-nutritional factors in triticale and the variable results obtained, this study was conducted to compare the five locally selected triticale cultivars in terms of chemical composition, digestibility and feedlot performance of lambs. Maize was used as the control grain.

Triticale grain of different cultivars (Usgen 7; Usgen 10; Usgen 14; Usgen 18; Usgen 19) was produced on adjoining plots on the Langgewens Experimental Farm (mean annual rainfall of 395 mm and temperature variation of 8°C – 30.5°C) in the Swartland area of the winter rainfall region. Grain of the different cultivars and maize were enriched by adding 50 kg of a commercially enriched concentrate (Rumevite® grain concentrate; Reg. no. V 7419, Act 36/1947) to 420 kg of grain. The grain was wetted with 4 l water/70 kg grain; thereafter, the concentrate was added and thoroughly mixed with the grain and stored. Mixtures

were made up to supply feed for 14 days only. The concentrate was formulated to supply protein (86% non-protein nitrogen), minerals, a growth promoter and a buffer.

The growth trial was carried out with 60 South African Mutton Merino (SAMM) lambs, about eight weeks of age with a mean initial live mass (± *SD*) of 18.8 ± 0.5 kg. Prior to the trial, the lambs were drenched with a broad-spectrum anthelmintic and vaccinated against *Clostridium ovitoxicum*. Each sheep was housed individually in an indoor pen equipped with feed and water trays. The lambs were adapted for a week to their respective diets during which time the lambs had free access to hay and, each day, received 300 g enriched grain/lamb (days 1 – 3), 500 g enriched grain/lamb (days 4 – 6) and *ad libitum* enriched grain (after day 6). The lambs were allotted randomly to the six experimental diets, five ram and five ewe lambs being fed each diet. The six experimental diets were available *ad libitum* to the lambs while lucerne hay (milled through a 12-mm screen) was supplied separately at about 10% of the *ad libitum* intake. The trial ended when the lambs reached a mean live mass (± *SD*) of 34.7 ± 0.8 kg at *c.* 20 weeks of age. Feed intake and live mass were measured weekly. Dry matter intake (DMI), average daily gain (ADG) and feed conversion ratio (FCR) were calculated for each lamb. Differences between treatment means were tested for significance by multifactor analysis of variance (with diet, sex and the interaction between these being factors). The analysis was conducted according to least squares procedures to accommodate uneven subclass sizes (Statgraphics 5.0, 1991). This was required because four lambs died, three were stolen from their pens and three were removed from the experiment owing to their inability to adapt to their diets. A contrast was computed between the maize diet and the mean of the five different triticale diets (SAS, 1990).

Carcass measurements were restricted to ram lambs. Dressing percentages were calculated from cold carcass weights.

The dry matter (DM), organic matter (OM), crude protein (CP) (AOAC, 1984), acid detergent fibre (ADF) (Van Soest, 1963), neutral detergent fibre (NDF) (Van Soest & Wine, 1967), the *in vitro* organic matter digestibility (IVOMD) (Engels & Van der Merwe, 1967) of the individual ingredients and the experimental diets were determined. The ether extract (EE), calcium (Ca), phosphorus (P), magnesium (Mg), copper (Cu), zinc (Zn) and manganese (Mn) contents of the experimental diets were also determined (AOAC, 1984). The tannin concentration in the grain was determined by the modified Jerumanis procedure (Daiber, 1975), while tripsin inhibitor activity was measured according to the procedure described by Smith *et al.* (1980).

The chemical composition and *in vitro* digestibility of the triticale cultivars and other ingredients used in the experimental diets are presented in Table 1. The CP content of triticale ranged from 10.2% (Usgen 18) to 11.6% (Usgen 14), which is slightly lower than the generally accepted values of 12.6%, Elsenburg Feed Database, 1992; 14%, Preston, 1988; 12.9 – 16.2%, Leterme *et al.*, 1991. The mean IVOMD (88.8%), ADF (3.68%) and NDF (20.4%) values were similar to the generally accepted values of 85.6%. 3.34% and 22.98%, respectively (Elsenburg Feed Database, 1992). Tannin concentration in the grain ranged from 0.10% (Usgen 10) to 0.14% (Usgen 14), while no tripsin inhibitors were detected.

The chemical compositions and digestibilities of the enriched grain mixtures are presented in Table 2. The CP contents of the experimental diets ranged from 13.0% (enriched maize) to 15.9% (Usgen 14). The IVOMD of the diets did not differ notably, averaging 91.7% (DE content of 16.3 MJ/kg DM). Enriched maize had a higher EE content (5.16%) than triticale (2.64%). The ADF and NDF contents of the diets had mean values of 3.49% and 16.57%. The mean Ca:P ratio of the enriched mixtures was 2.8:1 with mean Mg, Cu, Zn and Mn values of respectively, 0.3%, 9.1 ppm, 80.8 ppm and 74.5 ppm, respectively.

The CP content based on the measured intake of concentrate plus lucerne hay was 15.1%, 15.3%, 15.9%. 14.1%, 14.5% and 13.3% for Diets 1 – 6, respectively; greater than the range found for the grains. Lucerne hay constituted, respectively, 10.2%, 10.2%, 9.7%, 10.0%, 9.8% and 10.2% of the total DMI of the lambs on Diets 1– 6.

The grain and lucerne alone in the triticale diets supplied 27 g rumen undegradable protein (UDP) and 79 g rumen degradable protein (RDP), while the maize diet supplied 51 g UDP and 43 g RDP per lamb (based on bypass values of 25% for triticale grain, 60% for maize and 28% for lucerne hay as proposed by Preston, 1988). The commercial mixture supplied an additional 58 g protein/lamb daily and consisted of 50 g NPN. These values exceeded to the estimated UDP requirements (26 g/d) and RDP requirements (57 g/d) for a 20-kg lamb growing at 150 g/d (McDonald *et al.*, 1988). The diets supplied about 16.3 MJ DE/lamb daily; this is also above the DE requirements proposed by McDonald *et al.*, 1988 (8.4 MJ DE and 13.0 MJ DE/lamb daily for 20-kg or 35-kg lambs gaining 150 g/d).

Table 1 The chemical composition and *in vitro* organic matter digestibility of the seed of five different triticale cultivars and other diet ingredients (DM basis)

	Chemical composition (%)						
Ingredient	DM	OM	CP	ADF	NDF	Tannins	IVOMD (%)
Triticale grain:							
Usgen 7	89.7	97.7	10.75	3.70	20.4	–	90.2
Usgen 10	89.2	97.8	10.40	3.04	14.5	0.10	89.5
Usgen 14	89.1	97.7	11.59	3.57	21.7	0.14	87.6
Usgen 18	89.2	97.8	10.23	3.91	21.3	0.12	88.5
Usgen 19	89.0	97.9	10.37	4.19	24.3	0.11	88.2
Maize	88.3	98.6	9.73	3.00	9.0	–	90.4
Lucerne hay	92.2	93.5	15.87	40.0	53.8	–	53.0
Commercial supplement	94.5	50.5	58.70	0.61	2.20	–	83.4

Table 2 Chemical composition and *in vitro* organic matter digestibility (IVOMD) of the enriched grain mixtures (DM basis)

	Diets					
Item (%)	1 Usgen 7	2 Usgen 10	3 Usgen 14	4 Usgen 18	5 Usgen 19	6 Maize
Dry matter	87.6	86.7	87.2	88.1	88.0	87.3
Organic matter	93.6	94.3	93.2	93.8	94.6	94.5
IVOMD	90.9	93.2	90.5	91.2	91.2	93.2
Crude protein	15.0	15.2	15.9	13.9	14.3	13.0
Ether extract	2.76	2.49	2.75	2.77	2.44	5.16
Acid detergent fibre	3.13	3.37	3.81	3.53	3.89	3.22
Neutral detergent fibre	16.4	14.4	16.6	17.9	19.9	14.20
Calcium	1.07	1.12	1.43	1.19	1.05	1.21
Phosphate	0.43	0.43	0.46	0.42	0.41	0.38
Magnesium	0.33	0.32	0.38	0.33	0.31	0.32
Trace minerals (ppm):						
Copper	9.38	8.57	9.49	9.22	9.65	8.33
Zinc	77.7	81.5	79.3	78.2	72.5	95.9
Manganese	75.2	75.3	96.0	81.2	68.4	50.7

The mean DMI, ADG and FCR of the lambs consuming the different diets, as well as the dressing percentages of ram lambs are presented in Tables 3 & 4. In the absence of significant interactions between sex and diet, means are given for the main effects only. No significant ($P > 0.05$) differences were observed between diets in terms of grain intake, hay intake, total DMI, ADG, FCR and dressing percentage. Lambs on Diet 2 (Usgen 10), however, tended ($P = 0.10$) to have a poorer feed conversion ratio than lambs consuming Diet 1 (Usgen 7), Diet 3 (Usgen 14), Diet 4 (Usgen 18) and Diet 6 (maize). The ADG and FCR of lambs receiving Usgen 10 tended to be poorer (24% and *c.* 22%) than those of lambs receiving the other triticale cultivars ($P > 0.05$). The contrast between the maize diet and the mean of the five triticale diets indicated no significant differences in DMI or ADG but the difference approached significance ($P \leq 0.08$) for FCR; it was about 13% better on the maize diet. The mean dressing percentage was 46.8%.

Ram lambs had a 7.9% higher grain intake ($P = 0.08$) and 18.6% faster growth rate ($P = 0.01$) than ewe lambs. FCR tended (9.1%; $P = 0.12$) to be better in ram than in ewe lambs. Hay intake was not significantly related to gender.

The CP content of the five locally available triticale cultivars was lower than expected from the literature values. The lambs in this study did not utilize triticale as efficiently as maize in terms of FCR, as was reported by Reddy *et al.* (1975), who fed corn, wheat and triticale to steers in a feedlot. Although McCloy *et al.* (1971) found that intake of triticale was depressed relative to sorghum when fed to steers in a feedlot, no adverse effect on feed intake was found in our study. The marked, albeit not significant, poorer utilization of Usgen 10 by sheep is difficult to explain, although DMI was lower here than with the other cultivars. No differences were detected in the utilization when the other cultivars were compared. The results suggest that triticale can be used with as much success as that from maize when fed in enriched whole grain mixtures for lambs in a feedlot, although the FCR may be lower compared with maize. No exceptional detrimental effects of anti-nutritional factors in triticale on the utilization by lambs were detected. It is unlikely that the levels of tannins

Table 3 Means ± *SE* for dry matter intake (DMI), average daily gain (ADG), feed conversion ratio (FCR) and dressing percentage of lambs (growth interval from *c.* 19 kg to *c.*35 kg) fed grain enriched mixtures with five different triticale cultivars or maize

	Diets					
Parameter measured	1 Usgen 7 $n = 9$	2 Usgen 10 $n = 6$	3 Usgen 14 $n = 9$	4 Usgen 18 $n = 9$	5 Usgen 19 $n = 9$	6 Maize $n = 8$
Grain plus supplement intake (g/d)	927 ± 46	912 ± 56	977 ± 46	957 ± 46	929 ± 46	889 ± 48
Hay intake (g/d)	109 ± 8	104 ± 10	105 ± 8	106 ± 8	100 ± 8	99 ± 9
Total DMI (g/d)	1035 ± 52	1017 ± 63	1082 ± 52	1063 ± 52	1029 ± 52	988 ± 55
ADG (g/d)	198 ± 15	161± 18	209 ± 15	204 ± 15	186 ± 15	202 ± 16
FCR (kg DMI/kg gain)	5.53 ± 0.36	6.69 ± 0.44	5.26 ± 0.36	5.48 ± 0.36	5.60 ± 0.36	4.97 ± 0.38
Dressing percentage*	45 ± 1.2	48 ± 1.4	46 ± 1.1	46 ± 1.2	48 ± 1.2	48 ± 1.2

*Only measured on ram lambs (n = 4; 3; 5; 4; 4; 4)
No significant differences were observed between treatments

Table 4 Means ± *SE* for dry matter intake (DMI), average daily gain (ADG) and feed conversion ratio (FCR) for ram and ewe lambs (growth interval from *c.* 19 kg to *c.* 35 kg) fed grain enriched mixtures

Parameter measured	Sex		Level of significanc
	Rams (n = 24)	Ewes (n = 26)	
Grain plus supplement intake (g/d)	967 ± 28	896 ± 27	P = 0.08
Hay intake (g/d)	103 ± 5	104 ± 5	P = 0.91
Total DMI (g/d)	1071 ± 32	1001 ± 31	P = 0.12
ADG (g/d)	210 ± 9	177 ± 9	P = 0.01
FCR (kg DMI/kg gain)	5.34 ± 0.22	5.83 ± 0.21	P = 0.12

found would have depressed production, since Wiseman (1987) recommended the inclusion of limited amounts of grain sorghum in diets of poultry only when tannin concentrations exceeded 0.3%. Reasons for the variability among cultivars are not clear. Feeding value, calculated from FCR, averaged about 85% of that of maize (range of 65 – 94%). When triticale-based diets are lower than 85%, the price of maize-based diets, triticale would be more economical to feed than maize.

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