RESEARCH ARTICLE

Impact of *Moringa oleifera* Meal (MOM) Inclusion in Diet on Haemato-Biochemical Profile of Growing Surti Kids

Anushri Pandey[1]*, Rakesh J. Modi[1], Pravin M. Lunagariya[2], Manzarul Islam[3]

Abstract

The present research work was intended to assess the haemato-biochemical profile of 6-8 months old 18 growing Surti kids by utilizing the three diverse concentrations of *Moringa oleifera* meal (0%, 25% and 50%) by weight premix in concentrate part of feed. The diets were offered for 14 weeks to the experimental kids, which were randomly divided into three groups of six kids each, *i.e.*, 4 females and 2 males in each group. The haemato-biochemical parameters were measured individually at the beginning (Day 0), mid (Day 49) and end (Day 98) of the experiment. Results showed that haemoglobin and serum total protein, ALT (Alanine transaminase), AST (Aspartate transaminase), urea, glucose, calcium and phosphorus showed no significant difference, while serum creatinine, catalase, and SOD (Superoxide dismutase) activity differed significantly ($p<0.05$) at 0, 25 and 50% *Moringa oleifera* meal (MOM) inclusion. However, all the haemato-biochemical and oxidative parameters fell under the normal physiological range in all the treatment groups. It was concluded that *Moringa oleifera* meal up to 50% inclusion rate did not cause any adverse effect on the haemato-biochemical profile of Surti kids when fed for 14 weeks duration, while antioxidant levels in blood improved during the experiment, resulting into better immunity of growing kids. Thus, the MOM could be used to improve livestock system of small ruminant without any adverse effect on haemato-biochemical profile.

Key words: Haemato-biochemical profile, *Moringa oleifera* meal (MOM), Surti kids.

Ind J Vet Sci and Biotech (2023): 10.48165/ijvsbt.19.6.05

Introduction

Long-term sustainability of livestock husbandry due to climate change is challenging and is a major topic of concern for livestock researchers today. Limited availability of feed resources due to uncertain monsoon onsets and inability of animals to adapt their physiology as per changing climate are some serious issues faced by herdsmen. Animals require an appropriate amount of concentrate and replacement of the expensive protein supplements with easily available, cheap and good quality substitutes that helps farmers to gain profitability and to maintain the health of animals. One of potential tree forages, '*Moringa oleifera*' grows throughout the tropics. It is an indigenous native tree of the southern foothills of Himalayan region in north-western India and is cultivated in various tropical and subtropical areas. India is the largest producer of *Moringa oleifera* (commonly known as 'Drumstick tree, Horseradish tree, Ben oil tree, *Sehjan* or *Saragavo*) with an average production of 1.1 to 1.3 million tonnes fruit pods annually, which is cultivated in an area of 380 km^2 (Patel *et al.,* 2010). It is a leguminous, multipurpose, fast growing and drought resistant tree, which belongs to the family Moringaceae. It is protein-rich fodder used in animal ration, especially for goats.

Various experimental studies have concluded that use of *Moringa oleifera* leaves in animal ration improves the growth and performance of livestock (Jiwuba *et al.,* 2016). The feed intake and average body weight gain has been improved by replacing animal feed with *Moringa oleifera* leaves in the form of roughage or concentrate (Kholif *et al.,* 2015; Jiwuba *et al.,* 2016). Animals fed on high-quality protein rich fodder like *Moringa oleifera* show higher values of alanine transaminase (ALT) and urea concentration, while other haematological parameters (Yusuf *et al.,* 2017; Pandey *et al.,* 2021) and biochemical parameters (Patel *et al.,* 2023) remain constant. *Moringa oleifera* leaves are rich in various minerals like copper and sulphur, and an abundant amount

[1]Department of Livestock Production Management, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand - 388 001, India.

[2]Livestock Research Station, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand - 388 001, India.

[3]Pashu Sanshodhan Kendra, Ram na Muvada, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Anand - 388 001, India.

Corresponding Author: Anushri Pandey, Assistant Professor, Department of Livestock Production Management, Khalsa College of Veterinary and Animal Science, Amritsar-143001, Punjab, India, e-mail: anushripandey45884@gmail.com

How to cite this article: Pandey, A., Modi, R. J., Lunagariya, P. M., & Islam, M. (2023). Impact of *Moringa oleifera* Meal (MOM) Inclusion in Diet on Haemato-Biochemical Profile of Growing Surti Kids. Ind J Vet Sci and Biotech. 19(6), 21-25.

Source of support: Nil

Conflict of interest: None

Submitted 20/07/2023 **Accepted** 02/08/2023 **Published** 10/11/2023

of copper helps in reducing the internal parasitic load of *Haemonchus contortus* in goat and sheep, whereas sulphur provides efficient rumen microbial growth, hence improves ruminal functioning (Moyo *et al.,* 2011). Therefore, this study was aimed to investigate the impact of *Moringa oleifera* meal inclusion in diet of growing Surti kids on its haemato-biochemical and oxidative profile.

Materials and Methods

The present study was conducted at Livestock Farm Complex (LFC), College of Veterinary Science and AH, Anand, Gujarat (India) during the year 2021. Animal handling, care and sampling procedures were approved by Institutional Animal Ethics Committee (IAEC) of the College.

A total of eighteen Surti goat kids of 6-8 months of age were distributed randomly on body weight basis in three treatment groups with six kids (4 females and 2 males) in each group. The experimental kids were fed TMR individually as per ICAR feeding standard (2013). The *Moringa oleifera* meal (MOM) consisted of 78% *Moringa oleifera* dry leaves (CP%=28.6) and 22% *Moringa oleifera* stem powder (CP%=12.5) to produce 100% MOM that was used as concentrate (CP%=25.0). The kids were fed diets T_1, T_2 and T_3 as three different total mixed rations (TMR1, TMR2 and TMR3) containing 0, 25 and 50% MOM in concentrate and sorghum hay as roughage in 35:65 ratio for 14 weeks (Table 1).

Table 1: Ingredient composition (%) of Total Mixed Ration (TMR) of three dietary groups with different levels of *Moringa oleifera* meal (M)

Ingredients (CP %)	TMR 1 for Treatment 1 (M_0)	TMR 2 for Treatment 2 (M_{25})	TMR 3 for Treatment 3 (M_{50})
Concentrate (25.00)	35.00	26.25	17.50
Moringa oleifera meal (25.00)	0.00	8.75	17.50
Sorghum hay (9.20)	65.00	65.00	65.00

Blood samples were drawn from each animal on 1st (start), 49th (mid) and 98th day (end) of the study. The whole blood was used to estimate haemoglobin by using automated blood analyser (Mindray - BC-2800 VET). Serum biochemical parameters, *viz*., total protein urea creatinine AST (aspartate transaminase, and ALT (alanine transaminase, were estimated using automatic biochemistry analyzer by using kits supplied by Coral clinical systems, India. Calcium Phosphorus and Glucose were estimated using Meril kits on fully automatic biochemistry analyzer (MerilautoQuant 200i). Enzymes, *viz*., catalase (CAT) and superoxide dismutase (SOD) were analyzed as per the manufacturers' instructions using ELISA assay kits of Cayman Chemicals, USA on plate reader (TECAN Infinite M Nano).

The experimental data was analysed statistically using completely randomized design (factorial) (Snedecor and Cochran, 1994). The result is displayed as arithmetic mean ± standard error and the differences were considered statistically significant at 5% level of significance.

Results and Discussion

Haemoglobin and Serum Total Protein

The average values of haemoglobin and serum total protein in animals of all the treatment groups were statistically similar at the end of experiment. Further the period of sampling did not influence the serum total protein levels, though overall haemoglobin was found to be reduced significantly at the end of experiment as compared to initial value (Table 2). These results with respect to effect of treatment were in agreement with Jiwuba *et al.* (2016), Yusuf *et al.* (2017), Srivastav (2018), Kumar *et al.* (2020) and Patel *et al.* (2023), but disagreed with the findings of Babekar *et al.* (2015). The period effect on haemoglobin value was comparable with the report of Meel *et al.* (2018), while Patel *et al.* (2023) also observed significant decline in total protein with duration of experimental feeding of Moringa meal in Kids. In contrast to present finding on protein, many workers (Babeker *et al.,* 2015; Damor *et al.,* 2017; Kholif *et al.,* 2017; Meel *et al.,* 2018; Ahmed *et al.,* 2019; Zaher *et al.,* 2020) recorded elevated serum total protein levels in higher MOM fed groups. Despite higher protein content in *Moringa oleifera* leaves, serum total protein value showed no significant difference in present study because crude protein content of the MOM was kept equal to the commercial concentrate (Table 1, 2). Physiologically normal values of haemoglobin and protein in present study show that the *Moringa oleifera* being unconventional feed resource when replaced for commercial concentrate, supported good health status of the kids and the animals were not anaemic (Meel *et al.,* 2018).

Serum Glutamic Pyruvic and Oxaloacetic Transaminases

The average serum GPT/ALT and GOT/AST levels in all three treatment groups showed no significant differences for the period and treatment effect. Serum ALT and AST levels were within the normal physiological range (Table 2). The present findings were in agreement with the results of Damor *et al.* (2017), Srivastav (2018), Ahmed *et al.* (2019), Zaher *et al.* (2020) and Patel *et al.* (2023), but disagreed with observations of Mahmoud (2013) and Kumar *et al.* (2020). Non-significant effect of levels of these enzymes indicate that *Moringa oleifera* meal can be replaced up to 50% in the concentrate ration of growing Surti kids without causing hepatic damage.

Serum Urea, Creatinine, Glucose, Calcium and Phosphorus

The average serum urea and creatinine levels were found to increase with inclusion of *Moringa* meal in the diet of kids for 14 weeks, with significant difference in creatinine. Further the overall mean level of urea decreased significantly, while creatinine increased apparently at 49th day of sampling, particularly in T2 and T3 groups, although all these levels were within normal range of healthy animals. These findings supported the previous reports of Mahmoud (2013), kholif *et al.* (2017), Srivastav (2018) and Kumar *et al.* (2020), while contradicted with the findings of Yusuf *et al.* (2017), Zaher *et al.* (2020) and Patel *et al.* (2023), Physiologically normal values of present study showed that *Moringa oleifera* supplementation up to 50% inclusion did not impair kidney and liver functions of experimental kids. The average serum glucose levels of animals under all three diets were statistically similar, and it decreased significantly during period 3 when compared with the initial value overall and in T2 and T3 groups (Table 2). *Moringa oleifera* has antidiabetic properties containing flavonoids to inhibit the α-amylase activity

Table 2: Effect of feeding MOM on haemato-biochemical and oxidative profile of experimental animals

Parameter	Period	Treatment			Overall mean (P)
		T_1	T_2	T_3	
Haemoglobin (g/dL)	P1	10.00 ± 0.21	11.02 ± 0.39	9.88 ± 0.93	**10.30^a ± 0.35**
	P2	10.17 ± 0.51	10.05 ± 0.37	9.25 ± 0.46	**9.82^a ± 0.26**
	P3	8.97 ± 0.42	9.08 ± 0.49	8.10 ± 0.33	**8.72^b ± 0.25**
	Overall	**9.71 ± 0.25**	**10.05 ± 0.93**	**9.08 ± 0.86**	**9.61 ± 0.19**
Serum total protein (g/dL)	P1	5.78 ± 0.34	5.89 ± 0.24	5.98 ± 0.29	**5.88 ± 0.16**
	P2	5.44 ± 0.17	5.69 ± 0.33	6.06 ± 0.36	**5.73 ± 0.17**
	P3	5.06 ± 0.36	5.58 ± 0.32	5.61 ± 0.28	**5.42 ± 0.19**
	Overall	**5.42 ± 0.18**	**5.72 ± 0.17**	**5.88 ± 0.18**	**5.68 ± 0.10**
Serum SGPT (U/L)	P1	13.48 ± 1.00	13.64 ± 1.08	12.49 ± 1.18	**13.20 ± 3.45**
	P2	13.22 ± 0.53	13.39 ± 1.54	13.84 ± 0.86	**13.48 ± 4.19**
	P3	13.20 ± 0.74	13.99 ± 0.76	13.37 ± 0.47	**13.52 ± 0.06**
	Overall	**13.30 ± 0.60**	**13.67 ± 0.58**	**13.23 ± 0.37**	**13.40 ± 0.30**
Serum SGOT (U/L)	P1	80.08 ± 8.34	95.33 ± 6.47	89.96 ± 2.68	**88.45 ± 3.45**
	P2	99.33 ± 5.73	97.85 ± 8.96	97.54 ± 7.14	**98.24 ± 4.10**
	P3	100.99 ±10.07	101.59 ± 5.81	99.65 ± 6.25	**100.74 ± 4.32**
	Overall	**93.46 ± 4.64**	**98.25 ± 4.56**	**95.72 ± 5.81**	**95.81 ± 2.35**
Serum Urea (mg/dL)	P1	39.47 ± 2.56	36.78 ± 1.16	36.36 ± 2.09	**37.54^{ab} ± 1.15**
	P2	34.26 ± 1.55	34.63 ± 1.49	35.79 ± 0.07	**34.89^a ± 0.06**
	P3	33.68 ± 1.36	40.56 ± 1.73	41.06 ± 0.36	**38.44^b ± 1.08**
	Overall	**35.80 ± 1.21**	**37.32 ± 1.00**	**37.74 ± 0.95**	**36.96 ± 0.61**
Serum Creatinine (mg/dl)	P1	0.83 ± 0.11	1.06 ± 0.09	0.94 ± 0.08	**0.94 ± 0.06**
	P2	0.97 ± 0.12	1.17 ± 0.12	1.06 ± 0.07	**1.07 ± 0.06**
	P3	0.83 ± 0.07	1.18 ± 0.11	0.95 ± 0.11	**0.99 ± 0.06**
	Overall	**0.88^B ± 0.06**	**1.14^A ± 0.06**	**0.98^{AB} ± 0.05**	**1.00 ± 0.03**
Serum Glucose (mg/dL)	P1	63.21 ± 0.84	64.19 ± 1.27	64.21 ± 1.25	**63.87^a ± 0.63**
	P2	62.88 ± 0.97	61.70 ± 1.14	60.61 ± 1.49	**61.73^{ab} ± 0.70**
	P3	63.47 ± 1.33	60.49 ± 1.73	58.28 ± 1.33	**60.75^b ± 0.95**
	Overall	**63.19 ± 1.21**	**62.13 ± 0.07**	**61.03 ± 0.17**	**62.117 ± 0.47**
Serum Calcium (mg/dL)	P1	8.87 ± 0.20	9.12 ± 0.15	8.81± 0.18	**8.93^a ± 0.10**
	P2	7.60 ± 0.21	7.83 ± 0.21	8.04 ± 0.21	**7.82^b ± 0.12**
	P3	7.48 ± 0.33	7.79 ± 1.73	7.67 ± 0.36	**7.65^b ± 1.08**
	Overall	**7.98 ± 1.21**	**8.25 ± 0.07**	**8.17 ± 0.17**	**8.13 ± 0.12**
Serum Phosphorus (mg/dl)	P1	6.71 ± 0.20	6.88 ± 0.15	7.12 ± 0.18	**6.91 ± 0.10**
	P2	6.20 ± 0.21	6.43 ± 0.21	6.66 ± 0.21	**6.43 ± 0.12**
	P3	6.38 ± 0.33	6.82 ± 1.73	6.84 ± 0.36	**6.68 ± 1.08**
	Overall	**6.43 ± 1.21**	**6.71 ± 0.07**	**6.88 ± 0.17**	**6.68 ± 0.12**
Serum Catalase (nmol/min/mL)	P1	5.16 ± 0.84	7.53 ± 1.27	6.51 ± 1.25	**6.40^b ± 0.63**
	P2	5.73 ± 0.97	6.53 ± 1.14	7.22 ± 1.49	**6.49^b ± 0.70**
	P3	7.56 ± 1.33	11.63 ± 1.73	11.88 ± 1.33	**10.36^a ± 0.95**
	Overall	**6.15^B ± 1.21**	**8.57^A ± 0.07**	**8.53^A ± 0.17**	**7.75± 0.47**
Serum Superoxide Dismutase (U/mL)	P1	0.54 ± 0.09	0.41 ± 0.03	0.89 ± 0.02	**0.61^b ± 0.06**
	P2	0.78 ± 0.05	0.88 ± 0.03	0.93 ± 0.04	**0.87^b ± 0.03**
	P3	0.77 ± 0.07	1.02 ± 0.05	1.73 ± 0.39	**1.17^a ± 0.16**
	Overall	**0.70^B ± 0.05**	**0.77^B ± 0.07**	**1.19^A ± 0.15**	**0.88 ± 0.06**

Means with different superscripts (A, B) in row differ significantly (P<0.05).

Means with different superscripts (a, b) in a column differ significantly (P<0.05) between periods for a parameter.

and regulate glucose level in blood (Meel *et al.,* 2018). Present result was in accordance with the findings of Damor *et al.* (2017), Meel *et al.* (2018) and Srivastav (2018), while disagreed with the observations of others (Babeker *et al.,* 2015; Babiker *et al.,* 2017; Kholif *et al.,* 2017; Ahmed *et al.,* 2019; Al-Juhaimi *et al.,* 2020; Zaher *et al.,* 2020; Patel *et al.,* 2023). The results of present study fell under normal biochemical ranges in all the treatment groups indicating no harmful effect of plant flavonoids on blood glucose levels (Meel *et al.,* 2018) under 25 and 50% inclusion rates. Moreover, no significant differences were observed in the average serum calcium and phosphorus levels between groups, although the overall serum calcium level decreased ($p<0.05$) at the end of the experiment over the initial value. Kholif *et al.* (2017), Zaher *et al.* (2020) and Patel *et al.* (2023), recorded similar observations, while Damor *et al.* (2017) found improved mineral contents in higher MoM fed group.

Serum Catalase and Superoxide Dismutase

The average serum catalase activity of animals increased significantly ($p<0.05$) by 38.73% and 39.27% in T_2 and T_3 groups, respectively, when fed diet with increasing level of *Moringa oleifera* meal as compared to control due to antioxidant activity of *Moringa oleifera*. This finding supported the observations of Babiker *et al.* (2017) and Al-Juhaimi *et al.* (2020), who also reported higher catalase activity in *Moringa oleifera* fed groups as compared to control. A significantly ($p<0.05$) higher SOD was found in kids fed on 50% *Moringa oleifera* meal, while 0 and 25% groups were at par. Moreover the overall mean serum levels of both the enzymes were significantly increased at the end of experiment over the initial and 49^{th} day values (Table 2). These findings are in accordance with the results of Babiker *et al.* (2017) and Al-Juhaimi *et al.* (2019), who found higher total antioxidant capacity in serum of goats fed with *Moringa oleifera* as compared to control diet. Higher catalase and SOD levels positively impact the immune system of animals due to improved serum antioxidants levels by destroying free radicals formed normally during cellular metabolism (Al-Juhaimi *et al.,* 2019). Antioxidant levels in current experiment were significantly higher in animals fed with higher level of MOM as compared to control group showing positive effect of feeding MOM to animals for 3 months duration.

Conclusion

The study revealed that the inclusion of *Moringa oleifera* meal in the conventional concentrate supplement up to 50% showed no negative effect on the haemato-biochemical profile and also improved antioxidant status of blood in Surti kids.

Acknowledgement

The authors are thankful to the Dean of the faculty and Professor and Head of Livestock Farm Complex for the facilities provided for this work.

References

Ahmed, M.E., & Shaarawy, A.M. (2019). Effect of feeding *Moringa oleifera* forage on productive performance of growing kids. *Egyptian Journal of Sheep and Goats Sciences, 14,* 25-37.

Ali, S. (2017). Growth performance of goats fed *Moringa oleifera* leaf meal incorporated in concentrate mixture. *M.V.Sc. Thesis.* Maharashtra Animal and Fishery Science University, Nagpur, India.

Al-Juhaimi, F.Y., Alsawmahi, O.N., Abdoun, K.A., Ghafoor, K., & Babiker, E.E. (2019). Antioxidant potential of Moringa leaves for improvement of milk and serum quality of Aardi goats. *South African Journal of Botany, 129,*134-137.

Babeker, E.A., & Abdalbagi, Y.M. (2015). Effect of feeding different levels of *Moringa oleifera* leaves on performance, haematological, biochemical and some physiological parameters of Sudan Nubian goats. *Online Journal of Animal Feed Research 5,* 50-61.

Babiker, E.E., Juhaimi, F.A., Ghafoor, K., & Abdoun, K.A. (2017). Comparative study on feeding value of Moringa leaves as a partial replacement for alfalfa hay in ewes and goats. *Livestock Science, 195,* 21-26.

Damor, S.V., Pawar, M.M., Ankuya, K.J., Gami, Y.M., Srivastava, A.K., Chauhan, H.D., & Chaudhary, K.R. (2017). Effect of feeding different levels of Moringa (*Moringa oleifera*) leaves on growth performance of Mehsana kids. *Trends in Biosciences, 10,* 3190-3193.

ICAR (2013). *Nutrient Requirements of Livestock and Poultry*. Indian Council of Agricultural Research, New Delhi, India.

Jiwuba, P.C., Ahamefule, F.O., Okechukwu, O.S., & Ikwunze, K. (2016). Feed intake, body weight changes and hematology of West African dwarf goats fed dietary levels of *Moringa oleifera* leaf meal. *Agriculture, 13,* 71-77.

Kholif, A.E., Gouda, G.A., Morsy, T.A., Salem, A.Z.M., Lopez, S., & Kholif, A.M. (2015). *Moringa oleifera* leaf meal as a protein source in lactating goat's diets: feed intake, digestibility, ruminal fermentation, milk yield and composition, and its fatty acids profile. *Small Ruminant Research, 129,* 29-137.

Kholif, A.E., Gouda, G.A., Olafadehan, O.A., & Abdo, M.M. (2017). Effects of replacement of *Moringa oleifera* for berseem clover in the diets of Nubian goats on feed utilization, and milk yield, composition and fatty acid profile. *Animal, 12,* 964-972.

Kumar, M., Minj, N., Prasad, S., Kumar, R., Kumar, R., & Himkar, H.K. (2020). Effect of feeding *Moringa oleifera* leaf powder on haemato-biochemical profile of growing female Black Bengal goat under intensive system of management. *Journal of Entomology and Zoology Studies, 8,* 46-48.

Mahmoud, A.E.M. (2013). Effect of feeding on *Moringa oleifera* stems on productive performance of growing lambs. *Egyptian Journal of Nutrition and Feeds, 16,* 281-292.

Meel, P., Gurjar, M.L., Nagda, R.K., Sharma, M.C., & Gautam, L. (2018). Effect of *Moringa oleifera* leaves feeding on haemato-biochemical profile of Sirohi kids. *Journal of Entomology and Zoology Studies, 6,* 41-48.

Moyo, B., Masika, P.J., Hugo, A., & Muchenje, V. (2011). Nutritional characterization of Moringa (*Moringa oleifera* Lam.) leaves. *African Journal of Biotechnology, 10,* 12925-12933.

Pandey, A. (2021). Effect of feeding *Moringa oleifera* meal on growth performance of Surti kids. *Master's Thesis*. Anand Agricultural University, Anand, Gujarat, India.

Patel, S., Thakur, A.S., Chandy, A., & Manigauha, A. (2010). *Moringa oleifera*: A review of their medicinal and economical importance to the health and nation. *Drug Invention Today*, *2*, 339-342.

Patel, Y.G., Shah, S.V., Modi, R.J., & Lunagariya, P.M. (2023). The Effect of feeding *Moringa oleifera* meal on physiological and haemato-biochemical profile of Surti kids. *The Indian Journal of Veterinary Science and Biotechnology, 19*(4), 55-59.

Snedecor, G.W., & Cochran, W.G. (1994). *Statistical Methods.* 8th ed., The Iowa State University press, Ames, Iowa, USA.

Srivastav, J. (2018). Effect of supplementation of *Moringa oleifera* leaves on nutrient utilization and growth performance in goats. *Ph D. Thesis*. Rajasthan University of Veterinary and Animal Sciences, Bikaner, India

Yusuf, A.O., Mlambo, V., & Iposu, S.O. (2017). A nutritional and economic evaluation of *Moringa oleifera* leaf meal as a dietary supplement in West African Dwarf goats. *South African Journal of Animal Science, 48,* 81-87.

Zaher, H.A., Alawaash, S.A., Tolba, A.M., Swelum, A.A., El-Hack, A., Mohamed, E., & Abdelnour, S.A. (2020). Impacts of *Moringa oleifera* foliage substituted for concentrate feed on growth, nutrient digestibility, haematological attributes, and blood minerals of growing goats under Abu Dhabi conditions, *Sustainability, 12,* 6096.