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Potential of complete feed formulated from local raw materials on beef cattle performance

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Abstract

The study aimed to identify potential of complete feed formulated from local raw materials on and beef cattle performance. This study employed Completely Randomized Design (CRD) consisted of 4 treatments and 3 replications. The treatments consisted of T0= amofer-corn straw *ad libitum* (9.0% CP and 60.0% TDN); T1= Complete feed (10.0% CP and 55.0% TDN); T2= Complete feed (11.0 CP and 60.0% TDN); T3= Complete feed (12.0% CP and 65.0% TDN. The results showed that the treatment of amofer-corn straw significantly affected (P<0.01) chemical component i.e. crude protein, NDF, ADF, cellulose, and hemicellulose of complete feed. The treatment of amofer-corn straw significantly affected (P<0.05) feed consumption and Body Weight Gain (BWG). In conclusion, Treatment T3 containing 12.0% of CP and 65.0% of TDN is more effective to improve beef cattle performance.

Keywords: complete feed, fattening, in vitro, local raw materials

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INTRODUCTION

As the Indonesian population increases, the demand for high-quality meat consumption increases as well. According to a survey in 2016, approximately 70-80% of beef meat consumed is categorized as low-quality meat due to unavailability of fattening-based technology. Farmers prefer to keep their livestock with a cut-and-carry system (Ako 2019) with feeding technology. In addition to the lack access to the technology, the innovation in improving the quality of fattening feed is not also lack of improvement (Hasan et al. 2005, Tahuk and Dethan 2010). One method to anticipate this problem is to promote fattening system that aims to improve the quality of meat and to produce tender meat with low-fat content reaching up to1.68% (Sarwono and Arianto 2006). The process of fattening is considered important to produce high-quality meat. However, the process of fattening should be supported with strategies of technological approach through concentrates supplementation in the form of complete feed availability (Munasik et al. 2013).

Gustini and Permadi (2015) argued that the development of complete feed technology is one method or technique to produce concentrate-based feed which is provided for improving nutrient digestibility (Santra et al. 2002). In this process, the crude fiber and protein sources are mixed to generate homogenous source through physical treatment process and supplementation to positively promote feed effectivity and storage access. Complete feed supply is expected to fulfill nutritional needs of livestock and capable to improve the beef cattle enterprise improvement. Evaluation on different types of feedstuffs is very important in the feed formulation (Kumar et al. 2015). Therefore, the utilization of local raw materials provides accessibility for farmer due to the sustainable availability of raw materials. Complete feed is one method of utilizing potential local food source effectively (Beigh et al. 2017). Furthermore, the process will be more effective if innovation in feeding technology is implemented properly. There are three requirements in the production of complete feed: (1) Containing source of fiber (2). Containing source of energy (3) Containing source of protein. These nutrients must be provided to the animals through eating, drinking, or breathing (Hall et al., 2009). However, the nutritional quality in the feedstuff is very important and necessary to be first analyzed through testing by in vitro technique. Energy value is calculated based on in vitro analysis in accordance with published data of feedstuff and the final objective of feed analysis is to provide responses in relation to the given composition encompassing energy value of ruminant feed and the level of digestibility in the rumen (Krishnamoorthy et al. 1995, Kumar et al. 2015).

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Table 1. The feedstuff composition of the treatment on the dry matter

Feedstuff	%	T0		T1		T2		T3	
		CP	TDN	CP	TDN	CP	TDN	CP	TDN
Corn Straw	45	4.05	27	4.5	24.75	4.95	27	5.4	29.25
Gamal Leaves	15	1.35	9	1.5	8.25	1.65	9	1.8	9.75
Milled Corn	8	0.72	4.8	0.8	4.4	0.88	4.8	0.96	5.2
Rice Bran	10	0.9	6	1	5.5	1.1	6	1.2	6.5
Coconut Cake Meal	6	0.54	3.6	0.6	3.3	0.66	3.6	0.72	3.9
Onggok Flour	9	0.81	5.4	0.9	4.95	0.99	5.4	1.08	5.85
Tofu Waste	5	0.45	3	0.5	2.75	0.55	3	0.6	3.25
Urea	1	0.09	0.6	0.1	0.55	0.11	0.6	0.12	0.65
Mineral Mix	1	0.09	0.6	0.1	0.55	0.11	0.6	0.12	0.65

Chemical Laboratory of Animal Science Faculty, Hasanuddin University, 2018

MATERIALS AND METHODS

Material Research

All feedstuff of the research were obtained from a local raw materials consisted of corn straw, gamal leaves, milled corn, rice bran, coconut cake meal, onggok flour, tofu waste, urea and mineral mix. The nutritional content of those materials was presented in **Table 1**. Feedstuff composition of each treatment was presented in **Table 1**.

Research Procedure

Feedstuff such as corn straw is collected and cut into pieces using a chopper. Amofer processing was conducted by adding 1.0% local organic microorganism of corn straw weight, 2% urea and 60% sufficient water. Amofer-corn straw was fermented for 21 days in 100kg plastic drum with anaerobic condition. After fermentation, physical and chemical quality of feed from each sample was analyzed in Chemical Feed Laboratory Faculty of animal science, Hasanuddin University (2019). Physical and chemical quality was analyzed through the texture, colour, odour, and pH observation as well as in vitro evaluation of ration composition, dry matter and organic consumption.

Complete feed was composed of amofer-corn straw and other raw materials consisting of gamal leaves, milled corn, rice bran, coconut cake, cassava, urea, mineral mix, salt and coconut oil. Complete feed supply to the treatment group was performed 3 times in a day without other additional feed unless drinking water.

The treatments were applied randomly in individual pen. Firstly, pre-treatment was applied for 14 days, to eliminate the remaining effect of previous feed and to accustom the cattle to consume the complete feed. This is the adaptation period after the cattle passed the adaptation period, treatment was performed for 3 weeks.

Physical and Chemical Analysis

Parameters measured in the research were physical and chemical characteristics of the silage. The former included texture, colour, odour and pH observation. The chemical content was analyzed for protein content, crude fiber, fat, NFE, NDF, ADF, Cellulose, Hemicellulose according to the AOAC (1995) standard procedures Neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose, and hemicellulose content were performed by Goering and Van Soest (1970) method.

Fig. 1. Physical Characteristics of Complete feed

Research Methods

The study employed Completely Randomized Design (CRD) consisted of 4 treatments and 3 replications. The treatments consisted of T0= amofer-corn straw *ad libitum* (9.0% CP and 60.0% TDN); T1= Complete feed (10.0% CP and 55.0% TDN); T2= Complete feed (11.0% CP and 60.0% TDN); T3= Complete feed (12.0% CP and 65.0% TDN).

Data Analysis

The data was analysed using analysis of variance according to by *Completely Randomized Design* (CRD). The comparison among the means was analyzed with Duncan Multiple Range Test (DMRT) (Steel and Torrie 1980)

RESULTS AND DISCUSSION

The General Quality and Physical Characteristics of Complete Feed

The results of pH measurement, the texture, the colour and the odour of Complete feed caused by silage after 21 days of ensilage process are presented in **Fig. 1** and **Table 2**.

Table 2 shows that the pH average value of the treatments ranged from 4.10 to of 4.63. The range of pH values was relatively low. This was possibly due to the effect of the additional materials on complete feed. The additional material contributed to the increasing population of acid-producing bacteria and subsequently decreased the pH. The bacteria are generally found in corn straw, grass or other forages that are processed into silage and added with other materials to sustain the

Table 2. Degree of acidity (pH), texture, colour and odour of fermented Complete feed

Variable	Treatment			
	T0	T1	T2	T3
pH	4.63[a]	4.50[a]	4.30[ab]	4.10[b]
Texture	Soft	Soft	Soft	Soft
Colour	Brownish Yellow	Brown	Brown	Brownish Green
Odour	Weak	Quite Sour	Quite Sour	Quite Sour

Values sharing: Different superscript on the similar raw showed significant impact (P<0.05); T0= amofer-corn straw *ad libitum* (9.0% CP and 60.0% TDN); T_1= Complete feed (10.0% CP and 55.0% TDN) ; T_2= Complete feed (11.0 CP and 60.0% TDN); T_3= Complete feed (12.0% CP and 65.0% TDN)

Table 3. The average value of crude Protein, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Cellulose, Hemicellulose

Variable	Treatment			
	T0	T1	T2	T3
Crude Protein	4.23[a]±0.05	5.05[b]±0.07	7.15[c]±0.04	8.02[d]±0.02
NDF	60.25[a]±0.03	51.28[b]±0.01	53.85[b]±0.70	55.06[b]±0.03
ADF	40.24[a]±0.01	36.36[b]±0.04	33.15[b]±0.03	34.60[c]±0.01
Cellulose	30.12[b]±0.01	19.12[a]±0.70	19.10[a]±0.72	17.12[a]±0.01
Hemicellulose	20.12[b]±0.01	18.44[a]±0.01	17.14[a]±0.03	15.75[a]±0.01

[a,b,c,d] Means sharing: different superscript showed significant impact (P<0.01); T0= amofer-corn straw ad libitum (9.0% CP and 60.0% TDN); T1= Complete feed (10.0% CP and 55.0% TDN) ; T2= Complete feed (11.0 CP and 60.0% TDN); T_3= Complete feed (12.0% CP and 65.0% TDN)

sufficient bacterial population (Ridwan and Widyastuti 2001).

The treatment T0 appeared to be the highest pH compared to treatment TI, T2 and T3. This was due to the process of complete feed silage production where treatment T0 did not use preservatives or additive materials. Preservatives or additives are used to fulfill the prepared soluble carbohydrates in fermentation process and decrease the pH of the silage (Matsuhima 1979). Siregar (1996) stated that on the making of silage need preservatives to form acidic with the optimal acidity degree.

The physical silage showed positive signs marked by green to brownish-brown, yellowish colours in all parts of the silage. Texture, colour and odour did not appear as well as fungus on silage surface appeared only in a very small amount. Rusdy (2016) stated that the characteristics of the good silage included a less-sour odour, brownish-green, yellowish-brown colour, not cloudy, not slimy, low pH and visible texture.

Chemical Components of the Complete Feed

The components of the chemical content measured in this research are crude Protein, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), cellulose, hemicellulose. The chemical components were presented in **Table 3**.

Nutritional value of ruminant feed was determined through the concentration of its chemical composition, as well as the digestion rate in the rumen. Feed analysis aims to predict the response of productive animals when they were provided with treatment rations at different composition (Kumar et al. 2015). Chemical analysis of feedstuffs only provides nutrients content but cannot provide information on the fermentation value (Sallam 2005). Based on analysis of variance (ANOVA) in **Table 3** the treatment of amofer-corn straw significantly affected (P<0.01) crude protein, NDF, ADF, cellulose, and hemicellulose of complete feed.

The Content of Crude Protein

Based on DMRT, the result showed that T0 treatment was significantly different from T1, T2, and T3. **Table 3** indicated that the crude protein content of treatment T3 was higher than the treatment T0, T1 and T2. This indicated that the protein content of corn as complete feed material contained the highly digestible fraction particularly hemicellulose and cellulose. On the contrary, the components in the ADF, lignin and silica, are indigestible by the rumen microbes (Dooley 2019). High content of crude protein in treatment T3 was caused by the material content contained in the complete feed. Microbial activity in the rumen also affects the protein degradation optimally (Tahuk et al. 2017). Generally, the chemical content or the digestibility of feed also are affected by the amount of chemical composition material, feeding frequency, feed processing, as well as interaction effects of interactions in complete feed (Pond et al. 1995).

The Content of NDF and ADF

The highest content of NDF and ADF was found in the treatment T0 compared. **Table 3** showed a decrease of fermented NDF and ADF content for 21 days. This decrease was caused by the lactic acid bacteria *(Lactobacillus sp)*. The lactic acid produced by decomposing bacteria is able to decompose cellulose and hemicellulose lignin bond (Chuzaemi 1994). Cellulose and hemicellulose lignin bond caused the cell-bound content to dissolve in the *neutral detergent acid* solution. This caused the contents of the cell to increase while the component of the insoluble crude fiber of the cell wall in neutral detergent fiber (NDF) decreases.

The Content of Cellulose and Hemiseluosa

Based on the DMRT, the result shows that T0 treatment was significantly different from P<0.01) T1, T2, and T3 on cellulose and hemicellulose. The highest treatment was T0. The decrease of cellulose and hemicellulose in each treatment was caused by fiber digestive enzymes. The role of the enzymes was to degrade crude fiber in the fermentation process. Widya (2005), stated that the cellulose enzyme is one of the enzymes produced by microorganisms that degrade cellulose into glucose. It is similar to hemicellulose content produced by indigestible lignocellulose content. Lignin content in the corn straw as the primary material for complete feed was high. According to Sutardi (1980), the primary factors affecting the degradation of hemicellulose are ineffective chemical resistance and hemicellulose digestibility due to the lignin content that generates the formation of indigestible lignohemicellulose bond. In general, tropical forage and concentrate feed have a large proportion of lignified of

Table 4. The average consumption of dry matter (DM), crude protein (CP), and total digestible nutrients (TDN) in Bali Cattle supplied with Complete feed

Variable	Treatment			
	T0	T1	T2	T3
DM Consumption (%WG)	2.23^{a}±0.01	2.05^{b}±0.13	2.54^{c}±0.01	2.04^{d}±0.01
CP Consumption (kg/head/day)	0.34^{a}±0.01	0.45^{b}±0.01	0.50^{c}±0.01	0.83^{d}±0.83
TDN Consumption (kg/head/day)	4.04^{a}±0.42	4.25^{b}±0.03	4.35^{c}±0.07	4.56^{d}±0.01
TDN Consumption (g/kg/0,75)	49.51^{a}±0.01	56.12^{b}±0.01	63.10^{c}±0.01	65.05^{d}±0.01

^{a,b,c,d} Means sharing: different superscript showed significant impact (P<0.05); T0= amofer-corn straw *ad libitum* (9.0% CP and 60.0% TDN); T_1= Complete feed (10.0% CP and 55.0% TDN) ; T_2= Complete feed (11.0 CP and 60.0% TDN); T_3= Complete feed (12.0% CP and 65.0% TDN)

cell wall with low fermentation rate and digestibility that leads to the low digestibility and nutrition (Ibrahim et al. 1995). Fermentation will also convert hard structure to soft structure involving physical, chemical and biological changes. Materials with complex structure can be transformed into simplified structure through fermentation process and therefore, digestion process will be more efficient (Ribeiro 2000)

Feed Consumption

Feed consumption consists of the consumption of dry matter (DM), Crude Protein (CP) and consumption of total digestible nutrient (TDN) are presented complete feed in **Table 4**.

Based on analysis of variance, the treatment of fermented complete feed significantly affected (P<0.05) dry matter consumption, crude protein and TDN Consumption. The highest average consumption of dry matter was T2 treatment. Different feedstuff in ration formulation may result in different nutrient and palatability that affected the amount of cattle consumption. According to Sebarinoto et al. (1991), Krishnamoorthy (1995), the physical form of feedstuff may affect its palatability

The lowest and the highest consumption of crude protein were T0 and T3 treatment respectively due to the increasing supply of high protein primarily from other material mixes The average consumption of TDN was higher of T3 compared to T0, T1 and T2. The high TDN consumption was found on treatment T3 was due to the higher TDN content from gamal leaves than corn straw and corn cob.

Body Weight Gain and Feed Conversion Ratio

Average body weight gain and feed conversion ratio of Bali cattle supplied with Complete feed are presented in **Table 5**.

Table 5. Body Weight Gain (BWG) and feed conversion ratio (FCR) of Bali fed on Complete feed

Variable	Treatment			
	T0	T1	T2	T3
Body Weight Gain (BWG)	0.60^{a}±0.30	0.75^{b}±0.30	0.82^{c}±0.60	0.85^{d}±0.90
Feed conversion ratio (FCR)	10.56±0.72	11.73±0.68	9.50±0.42	9.60±0.30

^{a,b,c,d} Means sharing: different superscript showed significant impact (P<0.05); T0= amofer-corn straw *ad libitum* (9.0% CP and 60.0% TDN); T_1= Complete feed (10.0% CP and 55.0% TDN) ; T_2= Complete feed (11.0 CP and 60.0% TDN); T_3= Complete feed (12.0% CP and 65.0% TDN)

Analysis of variance In **Table 5** showed that the treatment of fermented complete feed significantly affected (P<0.05) Body Weight Gain (BWG) but the treatment did not significantly affect (P>0.05) feed conversion ratio (FCR). Based on DMRT the results showed that the T0 treatment significantly different from T1, T2, and T3 treatment. The T3 treatment was higher than that in T0, T1, T2 on BWG and FCR. This was due to the supplementation of Gamal leaves generating sufficient protein availability for livestock. This was also confirmed by a higher crude protein consumption (**Table 3**) on T3 treatment. Therefore, excessive protein can be used to increase body weight of cattle.

According to the NRC (1984), protein requirements for Bali cattle with 300 kg body weight with BWG target of 1 kg requires 760 g/day of daily protein consumption. Based on CP consumption in **Table 5**, treatment T1 and T2 was, in fact, sufficient to obtain 1 kg BWG. However, the average BWG for T1 and T was only 0.79 kg and 0.84 kg respectively. Likely it is associated with unmet energy to increase body weight gain efficiency. Although the protein was excessive. The excessive protein would not be able to be used optimally by the livestock.

CONCLUSIONS

Based on the results of this study, It can be concluded that Treatment T3 containing 12.0% of CP and 65.0% of TDN is more effective to improve beef cattle performance.

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REFERENCES

Ako A, Utamy RF, Nompo S, Khaerani PI, Sema, Rahmawati, Hasan S (2019) Heavy metal contents in beef cattle grazing in Landfill of Makassar City, Indonesia. OnLine Journal of Biological Sciences, 19(1): 46-50. https://doi.org/10.3844/ojbsci.2019.152.158

AOAC (1995) Official Methods of Analysis. 18th ed. Virginia, USA: Association of Official Analytical Chemists, Arlington.

Beigh YA, Ganai AM, Ahmad HA (2017) Prospects of complete feed system in ruminant feeding: A review. Vet World, 10(4): 424-437. https://doi.org/10.14202/vetworld.2017.424-437

Chuzaemi S (1994) Potensi Jerami Padi Sebagai Pakan Ternak Ditinjaua Dari Kinetika Degradasi dan Retensi Jerami dalam Rumen [The potential of Rice Straw As Livestock Feed Observed from Degradation Kinetics and the Retention of Straw in the Rumen]. Dissertation. Gajah Mada University, Yogyakarta. Retrieved from https://repository.ugm.ac.id/51996/

Dooley BC (2019) Characterization of corn stover pelleted with soybean meal or dried distillers grains on lactating cow performance, eating behavior, and rumen function. Graduate Theses and Dissertations. 17005.

Goering HK, Van Soest PJ, Washington, DC: ARS-USDA (1970) Forage fiber analysis. (Apparatus, reagents, procedures and some applications). USDA Agricultural Handbook, (379): 1-20.

Gustiani E, Permadi K (2015) Kajian pengaruh pemberian lengkap berbahan baku fermentasi tongkol jagung terhadap produktivitas ternak sapi PO di Kabupaten Majalengka [Study of the effect of complete feed formulated from corncob fermentation on crossed breed cattle productivity in Majalengka Regency]. Journal Peternakan Indonesia, 17(1). https://doi.org/10.25077/jpi.17.1.12-18.2015

Hall JB, Seay WW, Baker SM (2009) Review. Nutrition and Feeding of the Cow-Calf Herd: Essential Nutrients, Feed Classification and Nutrient Content of Feeds. Virginia Cooperative Extension. Publication 400-011.

Hasan S, Masuda Y, Shimojo M, Natsir A (2005) Performance of Male Bali Cattle Raised in the Marginal Land with Three Strata Forage System in Different Seasons J. Fac. Agr.. Kyushu Univ., 50(1): 125-128.

Ibrahim MNM, Tamminga S, Zemmelink G (1995) Degradation of tropical roughages and concentrate feeds in the rumen. Animal Feed Science Technology, 54: 81-92. https://doi.org/10.1016/0377-8401(94)00758-2

Krishnamoorthy U, Soller H, Steingas H, Menke KM (1995) Energy and protein evaluation of tropical feedstuffs for whole tract and ruminal digestion by chemical analysis and rumen inoculum studies in vitro, Animal Feed Sci. Technol., 52: 177-188. https://doi.org/10.1016/0377-8401(95)00734-5

Kumar D, Datt C, Das LK, Kundu SS (2015) Evaluation of various feedstuffs of ruminants in terms of chemical composition and metabolisable energy content. Vet World, January; 8(5): 605-609. https://doi.org/10.14202/vetworld.2015.605-609

Matsuhima JK (1979) Feeding Beef Cattle. Berlin Heidelberg, New York: Springer Verlag.

Munasik, Sutrisno I, Anwar S, Prayitno CH (2013) Physical Characteristics of the Pressed Complete Feed for Dairy Cattle. Internat. J. of Sci. and Eng., 4(2): 61-65. https://doi.org/10.12777/ijse.4.2.2013.61-65

National Research Council [NRC] (1984) Nutrient Requirement of Domestic NO.2 Nutrient Requirement of swine National Academy of Washington, D.C.

Pond WG, Church DC, Pond KR (1995) Basic Animal Nutrition and Feeding. 4th Edn., John Wiley and Sons Inc., New York: 273-289.

Ribeiro JMCR (2000) Treatment of Options Mediterraneennes Serie Seminaires 16(1991): 55-60.

Ridwan R, Widyastuti Y (2001) Membuat Silase. Upaya Mengawetkan dan Mempertahankan Nilai Nutrisi Hijauan Pakan Ternak [Making Silage. Efforts to Preserve and Maintain the Nutritional Value of Forage]. Warta Biotech, 15(1): 9-13.

Rusdy M (2016) Teknologi Pengawetan Hijauan Pakan [Preservation Technology For Forage Feed]. Rabbani publishing. Makassar. It:vii+148

Sallam SMA (2005) Nutritive value assessment of the alternative feed resources by gas production and rumen fermentation in vitro. Res. J. Agric. Biol. Sci, 1: 200-209.

Santra A, Karim SA, Chaturvedi OH (2002) Effect of Concentrate Supplementation on Nutrient Intake and Performance of Lamb of Two Genotypes Grazing a semiarid Rangeland. Small Ruminant Research, 44: 37-45. https://doi.org/10.1016/S0921-4488(02)00033-0

Sarwono B, Arianto BM (2006) Penggemukan Sapi Potong Secara Cepat [Rapid Beef Fattening]. Penebar Swadaya. Jakarta

Siregar SB (1996) Pengawetan pakan Ternak [Preservation of Feed]. Penebar Swadaya, Jakarta.

Soebarinoto, Chuzaemi S, Mashudi (1991) Ilmu Gizi Ruminansia. [Ruminant Nutrition]. Department of Feed and Animal Nutrition. Faculty of Animal Husbandry. Brawijaya University. Malang.

Steel RGD, Torrie JH (1980) Principles and procedures of statistics. A biometrical approach (2nd Ed.). New York: McGraw-Hill Book Company.

Sutardi T (1980) Landasan Ilmu Nutrisi, Jilid I. [Fundamental of Nutritional Science]. Department of Feed Science. Faculty of Agriculture, Bogor Agricultural University. Bogor.

Tahuk PK, Budhi SPS, Panjono, Ngadiyono N, Utomo R, Noviandi CT, Baliarti E (2017) Growth performance of male bali cattle fattening fed ration with different protein levels in smallholder farms, West Timor, Indonesia. Asian J. Anim. Sci., 11(2): 65-73. https://doi.org/10.3923/ajas.2017.65.73

Tahuk PK, Dethan AA (2010) Performance of Bali bull in greenlot fattening by farmers when rainy season in Timor Island. J. Indonesian Trop. Anim. Agric., 35: 257-261. https://doi.org/10.14710/jitaa.35.4.257-261

Van Soest PJ (1982) Nutritional Ecology of the Ruminant. Commstock Publishing Associates. A division of Cornell University Press. Ithaca and London.

Widya (2005) Enzim Selulase [The Cellulose Enzyme]. Retrieved on 20 December 2018 from http://kb.atmajaya.ac.id/default.aspxtabD=61&sra&id=84059