

Characterization of tropical cattle production units: Effect of sanitary management

Ponce-Covarrubias, José L.^{1*}; García y González, Ethel C.¹; Ruiz-Ortega, Maricela²; Rodríguez-Castañeda, Elsa L.³; Rodríguez-Castillo, José C.³

¹ Universidad Autónoma de Guerrero, Escuela Superior de Medicina Veterinaria y Zootecnia No. 3. Carretera Acapulco-Zihuatanejo km 106+900, Tecpan de Galeana, Guerrero, México. C. P. 40900.

² Universidad Autónoma del Estado de Hidalgo. Instituto de Ciencias Agropecuarias. Avenida Universidad km 1, Exhacienda Aquetzalpa, Tulancingo de Bravo, Hidalgo, México. C. P. 43600.

³ Benemérita Universidad Autónoma de Puebla, Facultad de Medicina Veterinaria y Zootecnia. Cuerpo Académico en Zootecnia y Bienestar Animal. Carretera Tecamachalco-Cañada Morelos km 7.5, El Salado, Tecamachalco, Puebla, México. C. P. 75460.

* Correspondence: jlponce@uagro.mx

ABSTRACT

Objective: To characterize dual-purpose cattle production units (PUs) and to identify the sanitary management that producers use with their herds.

Design/Methodology/Approach: Sixty (60) cattle producers were interviewed; the questions were related to the characteristics of the PU and the sanitary status. Four serum samples from the largest herd were sent to the laboratory to detect diseases.

Results: All the cattle producers surveyed were men between 20 and 50 years old. Of them, 40% have been devoted to the activity for 11 to 25 years. The PUs have on average 25 animals, 45% of producers have between 21 and 30 cows, and the highest percentage of animals are breeds Gyr (35%) and Sardo Negro (30%). Of producers, 65% tend to their sick animals. On the other hand, the laboratory studies showed that three cows were positive for Bovine Respiratory Syncytial Virus (BRSV), two cows were positive for type 1 bovine herpes virus (BoHV-1), or Infectious Bovine Rhinotracheitis (IBR) and parainfluenza 3 (PI3), and finally all the cows were positive for *Leptospira* sp. Hardjo.

Study Limitations/Implications: Under the conditions in which the study was conducted, it is costly to send samples to the laboratory. The producer with the largest herd financed the laboratory tests of the cows sampled. This information is useful for local producers with regards to the characteristics in which they produce them.

Findings/Conclusions: Dual-purpose cattle producers in the tropics produce at a small scale; and one of the largest PUs presents problems of abortive diseases.

Keywords: animal production, small scale, socioeconomic study, health, microorganisms.

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INTRODUCTION

In recent years, concern over food security has increased in Mexico and the world, due to the increase in population (9 billion inhabitants for the year 2050); therefore, there will be higher demand for beef (FAO, 2009). Presently, Mexico has 31 million heads of cattle: dairy (4.6%), beef and dual purpose (58.6%) (SIAP, 2016). The state of Guerrero has 1 million 3 thousand heads, in 42,000 production units (PUs), distributed regionally in Tierra Caliente (39%), Norte (18%), Costa Chica (16%), Costa Grande (16%) and the rest of the state (11%) (FIRA, 2017). In the country, to breed cattle there are different production systems, classified according to the technology used, from modernized to backyard systems (Rubio-Lozano *et al.*, 2013). Based on productive affinity, production systems for beef, milk and dual purpose were observed, where the main objective is producing milk and beef from the sale of calves and waste cows (SIAP, 2014). In cattle production systems, crosses between the species *Bos indicus* (Swiss American, Charolais and Simmental) and *Bos taurus* (Gyr, Guzerat, Brahman and Sardo Negro) are used, with the European breeds standing out as paternal lines and the Zebu as maternal (Castellanos-Gómez *et al.*, 2016). Breeding is conducted to take advantage of the rusticity and adaptation of livestock to tropical environmental conditions (Román-Ponce *et al.*, 2013). It is important but not sufficient to characterize and consider the size of cattle PUs, but rather also the amount of economic resources that are invested; it is also important to consider management, development of the activity, use of resources, and differences imposed by the producers' culture (Vilaboa and Díaz, 2009; Ruiz-Ortega *et al.*, 2021). Likewise, it is necessary to identify the socioeconomic characteristics of producers, size of the PU, and the commercialization of beef, milk and milk byproducts (Orantes-Zebadúa *et al.*, 2014; Ruiz-Ortega *et al.*, 2021). Some studies about the characterization of milk and dual-purpose cattle PUs consider them small-scale and sustainable production systems fit for tropical conditions (Orantes-Zebadúa *et al.*, 2014; Severino-Lendechey *et al.*, 2021). On the other hand, it is important to consider the sanitary state of cattle PUs, since cattle herds being healthy and producers not losing economic resources when covering treatment for the diseases depend on this. Indeed, in the tropics the diseases that affect dual-purpose cattle are brucellosis, tuberculosis, paratuberculosis, bovine viral diarrhoea (BVD), papillomatosis, leptospirosis (*Leptospira* sp.), among others (Gutiérrez-Hernández *et al.*, 2020; Ponce-Covarrubias *et al.*, 2021). Taking into consideration these diseases of economic importance for producers of the Mexican tropics, there is strong evidence of the presence of reproductive diseases, characterized by causing infertility, embryo death, malformations and abortions, provoking serious economic losses for producers (McGowan and Kirkland, 1995; Mellado *et al.*, 2021). These are cattle diseases with multiple etiologies (viral and bacterial), such as the bovine viral diarrhoea (BVD) and bovine 1 herpes (BHV-1) viruses, the causal agent of IBR, *Brucella* sp. and *Leptospira* sp. bacteria, which in addition to generating great losses for producers tend to be zoonotic diseases (Wounda *et al.*, 1999; Khodakaram-Tafti and Farhanikish, 2017). Because of this, the objective of this study was to characterize dual-purpose cattle production units (PUs), and to identify the sanitary management that producers use in their herds.

MATERIALS AND METHODS

Study area

This study was carried out in the ejido Coacoyulichán “Rancho el Aguacatillo”, municipality of Cuauhtepac, Guerrero, Mexico. The place belongs to the tropics and is located between geographic coordinates 16° 51' 48" LN and 99° 53' 24" LW. The highest average temperature takes place during the summer months (39.5 °C) and the lowest during the winter months (16 °C) (García, 2004).

Description of the study herd

The dual-purpose cattle producer has been working for 27 years and owns a cross of Swiss American and Sardo Negro. Currently, there are 185 cattle, of which 100 are multiparous cows, 30 replacement heifers, 50 calves for sale, and 5 registration bulls. The animals are vaccinated against the diseases of paralytic rabies (BIO ZOO, Zapopan, Jalisco, Mexico) and blackleg each year (Triple bovine bacterial, Zapopan, Jalisco, Mexico). Every 6 months parasites are removed (Sanfer[®] Ivermectin Animal Health, 1 mL for every 50 kg, Tlacopac, Mexico City, Mexico) and supplied with vitamins (Super B Complex, Tornel Laboratories, Naucalpan, Estado de México, Mexico). The reproduction is carried out by natural mounting and the animals do not receive complementary feeding in any season of the year. When it comes to productive aspects, there are normally 30 dairy cows from which milk and cheese can be sold, while calves and waste cows are for local sale. In the herd, there is no technical advice from a veterinarian.

Design and application of the survey

During the months of February to May, 2019, 60 dual-purpose cattle producers were interviewed. For that purpose, the formula proposed by Otzen and Manterola (2017) was applied, where the sample was limited by using a simple random sample and each Production Unit (PU) was considered as an experimental unit represented by each livestock producer. The questionnaire was constructed with 21 items and divided into five sections: data of the owner, data of the PU, description of the current production, characteristics of the PU, and animal health (Ruiz-Ortega *et al.*, 2021). The study variables were classified into: socioeconomic, sanitary and commercial, the types of variables used in this study were categorical and numerical (Agresti, 2013). It was decided to work with the PU described in the section “Description of the study herd” since it presented a larger number of animals, more sanitary problems and deaths in its livestock.

Anamnesis or clinical history

According to the survey applied, related to the health of cattle PUs, most of the producers mentioned not knowing about the diseases that affect their livestock (respiratory or digestive problems). Because of the situation experienced in the herd described in the section “Description of the study herd”, the interview showed that each year they had a high number of deaths of cattle of different ages; however, 28 cattle had died in the last two years. Therefore, anamnesis and inspection of the animals was conducted with the owner of this livestock, performing a physical exploration of the cattle affected, females

that had previously suffered abortions, nervous problems, respiratory problems, diarrheas, and animals that recently presented some disease with evident clinical signs. Because of the information obtained, the veterinarian decided to take some samples and send them to the histopathology laboratory (Indexx Laboratorios, Puebla, Mexico).

Taking and sending samples to the laboratory

Blood samples from the coccygeal vein were taken with Vacutainer tubes from four multiparous cows with background of abortions, diarrhea and respiratory problems. The tubes with the serum were marked with water-resistant ink, wrapped to fix the tape and placed in an ice box. The same day the samples were sent to the laboratory where a serologic diagnosis of the diseases was requested: bovine syncytial respiratory virus (BSRV), infectious bovine rhinotracheitis (IBR), parainfluenza 3 (PI3), leptospirosis and brucellosis, to the laboratory of Biología de Investigación Aplicada S. A. de C. V. (Indexx Laboratorios).

Statistical analysis

The information about the characterization of dual-purpose cattle PUs was analyzed using descriptive statistics; the percentage participation of each variable in the population was determined through frequency tables. The database was processed through multivariate analysis (conglomerate) for its grouping and classification. All the analyses were conducted with the SAS version 9.0 software (SAS Institute Inc., Cary, NC, USA). The results are presented in percentages, in the case of diseases, as positive or negative.

RESULTS AND DISCUSSION

Characterization of dual-purpose cattle PUs

In this study it was found that cattle producers in *ejido* of Coacoyulichán are between 20 and 50 years old, of which 100% are men. Similar results were found in dual-purpose cattle PUs in the states of Morelos, Sinaloa and Veracruz (Cuevas *et al.*, 2012; Chalate-Molina *et al.*, 2020). Ruiz-Ortega *et al.* (2021) found similar results to those in this study and to the ones mentioned before, in dairy cattle PUs in Valle de Tulancingo, Hidalgo. Contrary to these results, Granados-Rivera *et al.* (2018) mentioned that in the state of Tabasco the producers are older than 54.5 years and all men. Talking about the economically active population sector, the producers are of an adequate age (35 years), since for producers who are older than 50 years it is difficult to adopt new technologies to improve their cattle PUs.

Of the producers surveyed, 10% do not have any studies, 65% have primary school studies, and 25% have secondary school studies; 35% have been devoted to this activity for 5 to 10 years and 40% for 11 to 25 years. Finally, 100% of the producers have lands of their own for grazing (Table 1). When it comes to the producers' schooling, the results were similar to those found in the state of Tabasco, where most of the producers have primary school studies (52%). In the states of Hidalgo and Veracruz, 35.7 and 22% of the producers have higher studies. In this study, the producers have been devoted to this activity between 11 and 25 years, and all the producers have *ejido* lands for grazing. Consistently with these results, Granados-Rivera *et al.* (2018) indicate that most of the lands (74%) where they

graze their livestock are within an ejido. For their part, Ruiz-Ortega *et al.* (2021) mention that lands are privately owned (57.1%). Regarding the time they have been devoted to the activity, Méndez-Cortés (2019) indicate that it was 23 years. Therefore, the experience, the form of management, and the cultural patterns influence the destination of these dual-purpose cattle PUs in the tropics.

On the other hand, it was also evidenced that the PUs have between 10 and 40 animals. Of the producers, 16% have less than 10 animals, 22% have between 11 and 20 animals, and 45% have between 21 and 40 cows (Table 2). For their part, the highest percentage of animals is of breeds Gyr (35%) and Sardo Negro (30%), with milking of between 21 and 30 cows (75%). Similar information was reported by Granados-Rivera *et al.* (2018) where they explain that on average they have 39.5 ± 24.7 animals. In turn, Ruiz-Ortega *et al.* (2021) mention that in the Tulancingo Valley, Hidalgo, producers have on average 20 animals. On the other hand, in the state of Hidalgo there are breeds directed at milk production, such as Holstein, Brown Swiss and Jersey (Ruiz-Ortega *et al.*, 2021). For its part, in the tropics as in the states of Veracruz and Chiapas, they are Zebu breeds (Gyr, Sardo Negro, Guzerat, among others) with crosses with *Bos taurus* to take advantage of the hybrid vigor and rusticity of the animals (Román-Ponce *et al.*, 2013; Orantes-Zebadúa *et al.*, 2014).

Finally, the reproductive management of most of the PUs is done with natural mounting (88%) and when it comes to diseases, the livestock producers tend to their sick animals themselves (65%) (Table 2). Regarding the nutritional and sanitary management, most of the producers do not supplement their livestock. In this sense, Orantes-Zebadúa *et al.* (2014) mention that they supplement the animals with nutritional deficiencies during the time of drought. For their part, Ruiz-Ortega *et al.* (2021) express that they use reproductive technologies, dietary supplementation, and require advice from a veterinarian to treat the diseases. This situation is probably due to the age or schooling of the producers, since in the state of Guerrero most of the producers do not have any

Table 1. Socioeconomic characteristics of cattle producers.

Variable	Class	%
Age	Between 20 and 30 years	40
	Between 31 and 40 years	40
	Between 41 and 50 years	10
	More than 50 years	10
Sex	Male	100
Educational level	No studies	10
	Primary	65
	Secondary	25
Years dedicated to the PU	Between 5 and 10 years	35
	Between 11 and 25 years	40
	More than 25 years	25
Grazing paddocks	Own	100
	Rented	0

Table 2. Characteristics of the dual-purpose cattle PUs.

Variable	Class	%
Number of animals	Less than 10	16
	Between 11 and 20	22
	Between 21 and 40	45
	More than 41	17
Breeds of cows	Swiss American	25
	Gyr	35
	Sardo Negro	30
	Others	10
Milking cows	10 a 20 cows	28
	21 a 30 cows	55
	More than 30 cows	17
Reproductive management	Natural copulation	88
	Reproductive biotechnologies	12
Disease management	Consultation with the ZVD	10
	Consult another farmer	25
	Attend personally	65
What vaccinations do you give your cattle?	Bacterin Biobac [®] 7 ways	100
	Others	0

studies or primary school studies. For their part, producers from the state of Hidalgo and Veracruz have higher studies and accept new technologies to improve their cattle PUs.

Producers of tropical cattle generally do not accept advice from veterinarians. Therefore, a high percentage of the livestock die from diseases of unknown etiology and the producers have important losses (Escamilla *et al.*, 2007). The most common diseases that affect tropical cattle are blackleg, pneumonia, diarrhea, mastitis, anaplasmosis, parasitosis, derriengue and papillomatosis, among others (Orantes-Zebadúa *et al.*, 2014; Ponce-Covarrubias *et al.*, 2021). This study emphasized asking producers about who treats their sick animals; however, some producers mentioned diseases that they offered treatment for: respiratory problems, diarrhea, nervous problems, parasites and sporadic abortions (Table 3). Most of the producers treat their animals or take advice from another producer to deal with the diseases. However, despite applying vaccines, they have high mortalities in animals of different ages annually, situation that affects the producers' economy. These losses keep them from investing in the PUs, particularly in the sanitary aspect since commonly producers do not know the etiological agent of the diseases that affect their livestock. Therefore, it is important for them to have a deworming and vaccination calendar, to avoid the loss of the cold chain for the vaccines in order to prevent their deactivation and thus to reduce the mortality.

Disease diagnosis

In the country, the etiologic agent in more than 70% of the abortions of dual-purpose cattle is unknown, in addition to health problems that compromise the productivity of

Table 3. Effects from cattle deaths for the producer.

Variable	Class	%
Number of deaths per year	Less than 10	36
	Between 11 and 20	42
	Over 21	22
Time of the year	Rains	40
	Dry	60
What clinical signs does the cattle before dying?	None	5
	Abortions	51
	Nerve problems	15
	Respiratory problems	22
Have vaccinated animals died?	Others	7
	Yes	35
	No	65
	Economic	37
How does the death of your animals affect you?	Replacements	32
	Self-esteem	19
	Others	12

livestock herds (Escamilla *et al.*, 2007). Reproductive diseases are the ones that have the greatest effect on cattle PUs, since they place at risk the availability of calves and increase the production cost for producers (Rojo-Rubio *et al.*, 2009). In this study, the laboratory results confirmed three positive cows for the bovine syncytial respiratory virus (Table 4). Also, two cows were positive and two negative for antibodies against the glycoprotein B (gB) of type 1 bovine herpes virus (BoHV-1), causal agent of bovine infectious rhinotracheitis and IgG+IgM Parainfluenza 3(PI3). These diseases belong to the bovine respiratory complex with multifactorial etiology. Some studies mention that the etiological agents associated with reproductive disorders in cows include viral agents [bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR)] and bacterial agents [*Brucella abortus* and *Leptospira* sp. (Hardjo, Pomona, among others)], which affect the bovine females with high percentages of abortions (Martins and Lilenbaum, 2017; Larghi, 2018; Valas *et al.*, 2019). On the other hand, *Leptospira* sp. Hardjo 1:100 strain was identified for the four cows and the Pomona 1:100 strain for one positive cow (ID 001204), finding another two strains to which the same cow (ID 001204) was exposed (Grippotyphosa and Tarassovi 1:200) (Table 4). It is common that in cattle, the leptospirosis found frequently is the serotype Hardjo, because bovines are reservoirs of this serotype and contagion takes place between them from direct contact (Carmona-Gasga *et al.*, 2011). Some studies, where the serum prevalence of leptospirosis in tropical regions was determined, found high percentages for the serotype Hardjo (54.4%) (Escamilla *et al.*, 2007; Carmona-Gasga *et al.*, 2011). There are factors that favor the survival of *Leptospira* outside of the hosts, such as environmental moisture, causing for animals to acquire the infection. In the PU sampled the number of sick animals from leptospirosis is unknown, since only four cows were sampled. However,

Table 4. Abortive diseases in the production unit (PU) of the study ranch, El Aguacatillo.

ID	Disease	Interpretation	Results
S/P% ¹			
001204	Bovine Respiratory Syncytial Virus	24.64	Positive
400125		55.08	Positive
140126		-1.60	Negative
181322		66.30	Positive
Optical Density ²			
001204	Bovine herpesvirus type 1 (BoHV-1)	0.954	Negative
400125		0.042	Positive
140126		0.969	Negative
181322		0.040	Positive
S/P% ³			
001204	Parainfluenza -3(PI3)	13.82	Negative
400125		58.95	Positive
140126		11.10	Negative
181322		83.55	Positive
Tides of 1:100 (+) ⁴			
001204	Leptospira <i>SP</i> Bovine	Hardjo	Positive
400125		Hardjo	Positive
140126		Hardjo	Positive
181322		Hardjo	Positive

¹ Interpretation of the Bovine Syncytial Respiratory Virus (BSRV) Kit, S/P% value lower than 20 is negative; S/P% value higher than or equal to 20 is positive.

² Optical density (O.D.) higher than 0.5 is positive, and lower than or equal to 0.5 is negative.

³ S/P < 20 value is negative, S/P ≥ 20 value, and < 40 is positive 1, S/P ≥ 40 value and < 60 and 80 is positive 3, S/P ≥ 80 value and < 100 is positive 4 and S/P ≥ 100 value is positive 5.

⁴ Titration of 1:100 is considered positive (presence of antibodies). In the four cows the Hardjo strain was found, and in cow one (ID 0011204) the Pomona (1:100), Grippotyphosa and Tarassvi strains were also found with titrates of 1:200.

Reference: Myers (1985).

it is important to make evident the presence of the disease in the cattle herd. In general, the results from this study show the presence of BVD, IBR and leptospirosis, which can be due to the purchase of wombs or bulls from infected herds, and because quarantines or immunization of animals are not carried out.

CONCLUSIONS

The cattle producers from *ejido* Coacoyulichán, municipality of Cuauhtepic, Guerrero, produce at small scale with low technology, without training to address productive and sanitary problems of the cattle PUs. Likewise, the cattle PUs show that there are problems in the diagnosis and knowledge of diseases, as well as in the application of treatments of sick animals. Finally, important abortive diseases for herd health and the producer's economy were found in the PU where laboratory tests were made. It is necessary to train the producers for them to make correct decisions at the productive and sanitary level, contributing to suggest vaccination calendars, taking care of the cold chain for vaccines so they do not deactivate. It is also necessary to advise producers who are owners of animals

with abortive diseases, so that they do not spread to surrounding PUs, as well as to sample and corroborate suspicious cases in the veterinary histopathology laboratory.

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