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Characterization of backyard guajolotes (*Meleagris gallopavo gallopavo*) in tropical zones of Mexico

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Abstract

With the purpose of identifying the phenotypic flock characteristics and management system in the backyard guajolotes (turkey) production system in the Coastal region of Oaxaca, Mexico; a total of 768 guajolote breeders were surveyed in 54 municipalities.

The producers are mainly peasants, with productive units that have different backyard species. The most frequent feather colors were white in combination with black, and black. Forty-nine % of breeder used a system of partial scavenging and nighttime housing; 57% used some kind of identification. Partial scavenging in addition to food supplied to the birds is a characteristic of this production system: 50% of the breeders feed them maize and its by-products and 22% feed them fruits,. For adult guajolotes the daily intake was estimated at 595 g. With regard to reproduction, the proportion between males and females was 1:4; with 2 inseminations, prior to natural incubation; the puberty age was 9 months old, with 13 eggs in each incubation cycle. The overall fertility was 77% with 85% hatchability; the incubation period was 30 days. Eighty-nine % of breeders store fertilized eggs prior to incubation; 66% check the eggs for hatchability during incubation, while 87% have developed some kind of sexing technique for poults. The guajolotes often get sick because of the high temperature and rain. The more frequent clinical signs are ataxia 30%, dyspnea 24% and anorexia 21%; the most frequent illness is Avian Pox (53%). Traditional medicine makes use of different regional vegetables. The age for sale was 1.2 years old, with an average weight of 9.4 kg for a guajolote male and 7.2 kg for a hen. Production costs of males and females were \$74.6 and \$93 US dollars respectively, which are higher than the sale price; 62% of the production is destined for consumption and 23% for opportunistic sales. During traditional breeding of guajolotes in Mexico, management techniques have been developed that are

more applicable to the peasant farmer conditions; however, it is possible to adapt or develop new technologies to improve the general production characteristics.

Key words: Creole turkey, livestock, native turkey, traditional systems

Introduction

In Mexico the breeding of guajolotes or turkey (*Meleagris gallopavo gallopavo*) is a complementary activity to household economics in rural areas, while in urban zones it is increasingly less significant and has a tendency to disappear (Mallia 1999); it is characterized for being a backyard activity and in many occasions for partial scavenging. The producers are usually peasants who breed the guajolotes with traditional methods with rustic installations adapted in their own houses, with the household members providing the labor and with low production efficiency (Jerez et al 1994).

The importance of backyard aviculture is such that recent estimates in Mexico indicate that 10% of the national avian inventory is found in the backyard production system (INEGI 1994). However, studies in Mexico covering the subject of native poultry genetic resources are scarce. Of these resources guajolotes are the main specie because of their origin and domestication in the national territory (Henson 1992). The lack of precise inventories, data bases and information about the backyard guajolote productive behavior in Mexico (SAGARPA 2003), is due to insufficient interest and very few published studies on this species. These limitations make the study and understanding of traditional breeding problems very complex and therefore it is difficult to suggest actions to surpass the limitations of backyard breeding conditions (Rejón et al 1996).

The Mexican government recognizes that the study of the native guajolote is an urgent necessity (SAGARPA 2003) since the possibility of short term native-guajolote extinction is not ruled out (Aquino et al 2003). This would be a loss of a valuable genetic resource that is adapted to the environmental conditions in the country (Rodríguez et al 1996). An important problem is hybridization of the native guajolotes and foreign commercial strains. This problem very frequently arises in backyard guajolote breeding areas where small scale trading of synthetic commercial turkey strains is done. These circumstances are the cause for the loss of valuable genetic characteristics of the native guajolote such as rusticity and resistance to certain diseases, that have been studied insufficiently (Trigueros et al 2003).

At present, the conditions of native guajolote breeding in Mexico are unknown. For example, in the state of Oaxaca, the VII census of farming and livestock breeding of 1991 reported an inventory of 430,032 guajolotes (INEGI 1996). In the Central Valleys of this state, Jerez et al (1994) reported that the domestic guajolote has the second place within the overall inventory of backyard poultry breeding at 22% following chickens, hens and cocks that represent 87%. The breeding of backyard native guajolote continues in regions like the Coast of Oaxaca (Camacho-Escobar et al 2006); however, due to lack of technology production is inefficient. Although the contribution of guajolote breeding to the overall national poultry production is low, the intrinsic value of this species is big, due to the genetic potential capable of being commercially exploited and their adaptation to

geographic and environmental conditions of the country. In addition the guajolote has an enormous cultural, economic and social importance in rural zones (Mallia 1998).

The objective of this research was to learn the phenotypic characteristics and management procedures in the production systems of backyard guajolotes in the Coastal region of Oaxaca, Mexico.

Materials and methods

The research was done in Mexico from September of 2005 through August of 2006. The studied area is located in the Coastal region of the state of Oaxaca and it is divided in 3 districts: Jamiltepec, Juquila and Pochutla which are integrated in 54 municipalities. The Coastal region of Oaxaca is located between the coordinates 16° 45' latitude north and 96° 20' longitude east and it has an area of 10,700 km².

Prevalent ethnic groups in the region who were interviewed because of having backyard aviculture activity are: mestizos and afromestizos in the three districts; zapotecos in the Pochutla district, mixtecos in the Jamiltepec district and Chatinos in the Juquila district.

During this study a total of 768 backyard producers were interviewed, followed by a previously prepared questionnaire given to an equal number of backyard breeders over 18 years of age. The questionnaire had 52 open questions and was given to communities and families selected at random in the studied area. The interview was previously tested with 120 producers in all the regions, to correct the questions; the municipalities and the producers in this test there were selected randomly. In each of the 54 region's municipalities, 12 random selected producers were interviewed. The sample size was estimated with 14,685 families in the region (INEGI 1994), 84.5% have some type of live stock activity and 57.5% of them (4,995 producers) have backyard aviculture and guajolotes (Camacho et al 2006). To calculate the sample size the equation proposed by Mendenhall et al (1995) was used with an error of estimation of 5%.

Economic, social, and cultural information about the producers was obtained as well as information concerning the general management, sanitary, and phenotypic description of the birds, their productive parameters, utilization or profitability and breeding cost of backyard guajolotes. When it was possible, pictures were taken for the phenotypic characterization.

With the collected data the distribution frequency and descriptive statistic values were calculated. The data were analyzed by the UNIVARIATE procedure of the SAS software (SAS Institute 1997).

Results

The backyard producers were in all the predominant types of climate: mild sub-humid C(w1), semi-dry warm Bs1hw, warm sub-humid Aw1, semi-warm sub-humid (A)C(w1) and warm humid Am(f). The prevailing vegetation is diverse in the Coastal region where the following can be found: in the highlands with oak trees, pine trees, thorn scrub, and lands near the coast with tropical semi-deciduous forest, evergreen seasonal forest, deciduous seasonal forest, mangrove, popal, palm groves, savanna, humid and sub-humid tropical forest and pasture. Back yard guajolotes were in all places, from hot tropical lands to warm pine woods.

Producers' characteristics and flock size

Backyard poultry breeders in the Coastal area of Oaxaca, Mexico, have an average monthly income of \$145 USD \pm 111 (SD) and the families' average size is 5.87 ± 2.75 members. The schooling level of the backyard producers are elemental school 83%, high school 15% and graduate 2%. The principal economic activity of the backyard producers surveyed is related to a primary production: agriculture, cattle breeding and fishing (Table 1); however, the work and activities they perform are very diverse and include the unemployed all the way to college graduates and even those who receive funds from relatives working illegally in the United States.

Table 1. Principal activity of the backyard producers in the Coastal region of Oaxaca, México

	Frequency	Percentage
Farmer	494	64.3
Owns a business	76	9.9
Housewife	59	7.7
Unemployed	57	7.4
Worker	52	6.7
College graduate	16	2.0
Retired	8	1.0
Migrant	6	0.8
Total	768	100

The responsibility for backyard breeding of guajolotes usually falls on women, who assume the care of the animals as one more domestic activity. In 67.8% of the production units, the housewives take care of them, but other family members also help in this activity. In 23.1% of the backyard producers the care of the animals is not assigned to any particular family member; in this case the entire family contributes their work. When backyard production was the responsibility of the children (5.4%) the main reason is that the parents work outside the home. In families that do not have children or are studying outside of the community, the neighbors help with the care of the animals; this situation was found with 3.7% of the producers.

The consumption of animal protein in 38% of the producers is mostly obtained from chicken or hen meat or eggs produced by themselves; 23% consumed beef, 11% guajolotes and 8% pork; 19% consumed wild animals that they occasionally hunt, like deer, iguana, armadillo, squirrel, badger and wild boar. If the communities are close to water they also

consumed shrimp, sea bream, prawn, crab, oysters and fish; 0.9% do not eat meat. The data show the poverty level of families in the region.

In the backyard production units, the species more frequently bred are: hens, guajolotes and pigs (498, 434 and 107 flocks respectively; Figure 1). The flock's average size of guajolote backyard production units are 5 ± 3.4 , the maximum size was 34 and the minimum 1. Frequently, the guajolotes are in the same flock with other domestic species, but hens are the more usual companion.

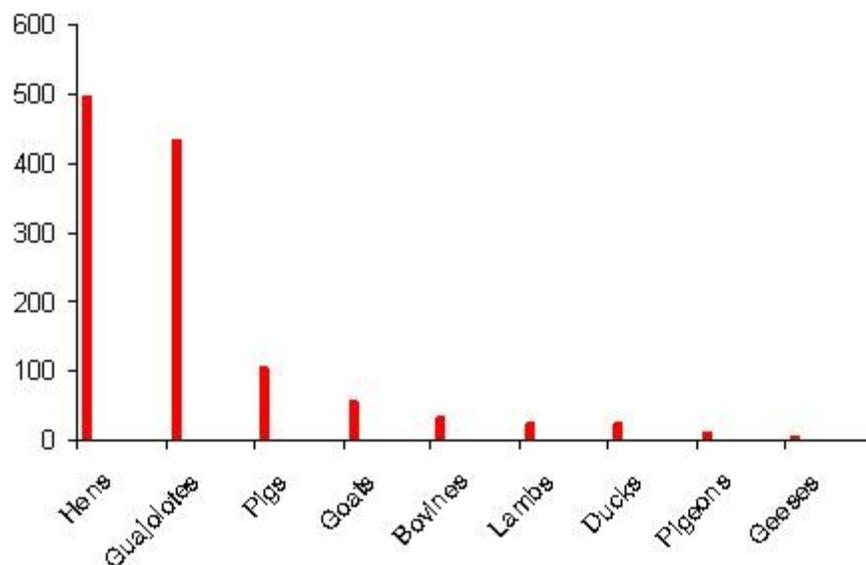


Figure 1. Frequency of domestic species in backyard production units in the coastal region of Oaxaca, México

Phenotypic characteristics

Due to the characteristics of backyard breeding of guajolotes in the Coast of Oaxaca where most of the guajolotes remain in conditions of semi-scavenging and are not confined, only the color of the feathers and the skin color of the tarsus were considered for the phenotype. These characteristics were selected because they could be observed in the guajolotes during the interviews, and are the most important phenotypic characteristics that FAO considers to describe native animal genetic resources (FAO1987).

Variability in the color of the feathers was observed. Pure colors and combinations of two or more colors were detected; however, in this study were only considered: black, white, grey, brown, yellow and red colors and their combinations (Table 2).

Table 2. Frequency of the colors observed in the feathers of backyard guajolotes in the Coast of Oaxaca, Mexico

	Frequency ¹	Percentage
Black	152	29.2
Brown	12	2.4
Grey	9	1.9

White	8	1.6
Red	2	0.5
White / black	157	30.3
Black / brown	28	5.4
White / brown	24	4.7
Black / grey	16	3.2
White / grey	14	2.7
Black / yellow	5	1.0
Brown / yellow	1	0.3
White / red	1	0.3
White / black / brown	47	9.2
White / grey / black	23	4.5
White / grey / brown	7	1.4
Black / grey / brown	5	1.0
White / red / grey	1	0.3
Total	512	99.9

¹Guajolotes in which was possible to get the characterization of the color of the feathers

In Mexico studies of phenotypic characterization of the native guajolote breeds do not exist. As a result, this kind of study is the first to produce information about some of the phenotypic characteristics. The skin color in the tarsus was used as a descriptive criterion. In this study besides white, yellow and black colors, pink, brown and grey colors were also observed (Figure 2).

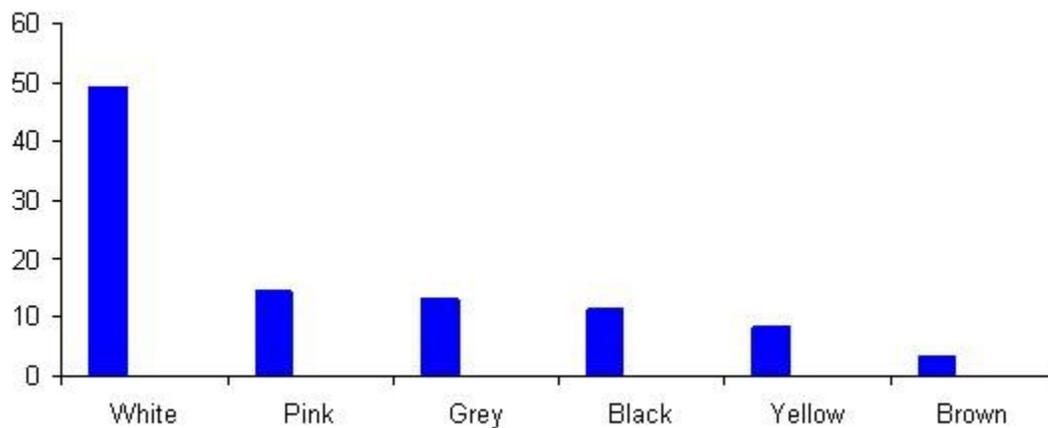


Figure 2. Frequency of color observed in the tarsus skin of the backyard guajolotes in the Coastal region of Oaxaca, México

Management

One of the characteristics of backyard breeding in the coast of Oaxaca is the generalized use of scavenging, complemented by other types of feeding such as maize or its by-products, fruits and vegetables, food scraps and other agricultural products.

Due to the fact that this species wanders into farm land and other nearby lots, 77% of the breeders reported that the guajolotes prefer to rest and seek for food in places close to shaded places near trees, tall grass, places close to rivers and lagoons. For 13.5% of the breeders the places more frequented by their fowl are streets, roads and rural roads; while 9.5% report that they go to farm land, nearby lots and neighbors yards.

Almost half of the backyard breeders in the coast of Oaxaca use pens or some type of construction designed to hold their fowl; the rest lets them roam free, or tied by one leg or in small individual cages (Table 3).

Table 3. Places where the backyard guajolotes stay the night in the Coastal Region of Oaxaca, México.

	Frequency	Percentage
Pen	374	48.6
In high places	309	40.2
Any place	79	10.3
Cages	3	0.4
Tied	2	0.3
Wooden boxes	1	0.2
Total	768	100

Frequently the guajolotes lose their way back to the homestead, or are stolen as their taste and sale price are very much valued. To lessen these problems, breeders have developed some identification system to demonstrate ownership of the bird (Table 4).

Table 4. Identification techniques used for backyard guajolotes in the coastal region of Oaxaca, Mexico.

	Frequency	Percentage
Thread	276	35.9
Cutting	94	12.2
Painting	48	6.2
Shaving	15	2.0
Piercing or notches	7	0.9
Fractures	1	0.2
No identification	327	42.6
Total	768	100

One of the most frequently used systems is to place a colored thread piercing the skin in a visible place, usually the head, tarsus, wings, neck and snood. Another technique is the mutilation of a phalanx, shortening of the wing feathers and notches in the neck or snood. Also, it is frequent the use of paint, fracturing the wing carpus and metacarpus, and shaving feathers mainly in the neck.

Feeding

The surveys show that the feeding of backyard guajolotes is diverse. In the morning they are given some feed and then they are free to wander and scavenge for their food in the nearby farm land and empty lots. The basis of their feed is maize or its by-products, vegetables, food scraps, commercial balanced feed, grains, pasture and insects. Less frequently they are fed with sesame seeds, peanuts, whey, banana leaves and maize or wheat fritters. Frequently, the guajolotes are seen eating fruit that grow in the region, when they find it on the road or discarded; some of these fruits are papaya, mango, pineapple, banana, water melon, squash, tamarind, lime and tangerine.

Just like the farmers' diet, maize is the base of feeding for the guajolote. It is given whole, broken, dried and soaked; in the form of fresh, hard or soaked tortilla, and a maize by-product called *masa* and *nixtamal*.

Table 5 shows the type of feeding in the backyard production units of guajolotes.

Table 5. Type of feeding in the backyard production units of guajolotes in Coast of Oaxaca, Mexico.

	Frequency	Percentage
Maize, tortilla or its by-products	388	50.1
Fruits	170	22.2
Vegetables	81	10.6
Food scraps	54	7.1
Commercial feed	39	5.0
Grains	18	2.5
Grazing and insects	18	2.5
Total	768	100

In the backyard breeding in the Coast of Oaxaca, only 33.8% of the producers use commercial feed. The commercial balanced feed is given very few times to adult guajolotes; the main reasons are the high cost of it in rural communities and the high intake. When the balanced feed is used, it is always mixed with broken maize and is given mainly to the fowls to ensure a faster grow in order to go beyond the first three months of high mortality rate.

The feed is given once a day, usually during the morning, this is because the birds that are not kept in pens go to scavenge and if they have had nothing to eat they tend to go far in search for food and then get lost easily. When the feed is dry or as grains, it is thrown directly to the ground; if the feed is wet like the *nixtamal* or food scraps, it is given in small containers or on plastics lids.

Although backyard breeders do not keep productions records, it was possible to estimate the daily intake of food of adult guajolotes from the information given by the breeders who fed their birds with maize or commercial feed. The breeders estimated the quantity of food that was given daily to the guajolotes. The estimated mean daily intake of food for adult backyard bred guajolotes under intensive conditions was 595 g (\pm 293) with maximum of

1,000 g and minimum of 286 g. Table 6 shows the same variable in semi-scavenging conditions.

Table 6. Means of daily feed intake and feed conversion estimation of Backyard guajolotes in semi-scavenging conditions in the Coast of Oaxaca, Mexico.

	Male	SD	Female	SD
Daily feed intake ¹ , g	286	± 263	286	± 263
Total feed intake ¹ , kg	127	NE	125	NE
Feed Conversion ²	13.5	NE	17.4	NE

¹The feed intake could be over-estimated as frequently breeders declared the total consumption of the fowls including chickens and other avian species.

²Calculated to total weight of 9.4 kg and 7.2 kg for males and females respectively.

NE Not estimated.

Reproductive parameters

Creole guajolotes show a seasonal reproductive behavior; which occurs during the long days (from April to June). The productive and reproductive parameters of the guajolotes in the Coast of Oaxaca, Mexico are shown in Table 7.

Table 7. Means of reproductive parameters of the backyard guajolote breeding in the Coastal region of Oaxaca, Mexico.

	Mean	SD
Ratio male : female	1:4.2	± 1.6 females
Number of natural inseminations before ovoposition	2.3	± 1.2
Puberty reaching age, months	9.4	± 3.2
Number of eggs / laying cycle	13.0	± 4.0
Incubation period, days	29.7	± 5.2
Overall fertility of incubated eggs, %	76.9	± 12.3
Hatchability of fertile eggs	85.0	± 17.7
Time between different laying cycles, months	3.2	± 1.9
Poults breeding period, months	2.7	± 5.3

The management of the reproductive process is important in backyard aviculture because it guarantees continuity of production. Frequently, the breeders do not give much importance to the pairing between males and females in the flock, because conditions of partial scavenging, help avoid territorial conflicts among adult males combined with the size of the flock which rarely exceeds 30 individuals. Producers prefer to raise males rather than females due to their larger weight; however, females are appreciated primarily for their nesting capacity, incubation and maternal instinct.

When the female guajolotes start laying eggs, 88.6% of the breeders collect the eggs for safekeeping during the period of time that the laying of eggs last and before the bird tries to incubate them, while the remaining 11.4% do not touch the eggs leaving them in the nest. Those who collect the eggs, keep them in a dry and cool place (Table 8).

Table 8. Objects used to keep guajolote’s fertile eggs in the Coastal region of Oaxaca, México.

	Frequency	Percentage
Plastic container	342	44.5
Calandra lark nest	164	21.4
Do not take them out of the nest	87	11.4
Cushioned container	68	8.8
Refrigerator	58	7.5
Wooden boxes	33	4.3
Cardboard egg trays	6	0.8
Plastic bags	6	0.8
Dried fruit shells or <i>guajes</i>	4	0.5
Total	768	100

In the cost of Oaxaca, the eggs are placed in plastic containers, other bird nests, plastic bags, wooden boxes, cardboard trays for eggs or even dried fruit shells or *guajes*.

Once the female guajolote starts to incubate the eggs, the producer takes an average of 16 (± 6.79 SD) before verifying the ability to incubate eggs. From the total number of guajolote producers, 65.9% use some method to recognize if a viable embryo has been developed, or if the egg will not hatch a poult. (Figure 3).

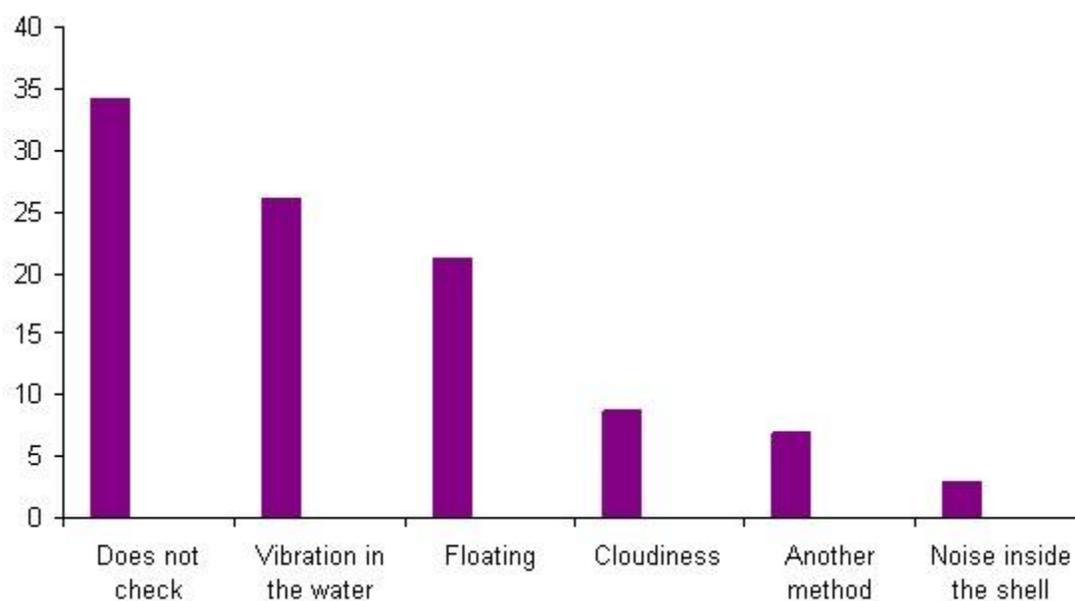


Figure 3. Methods to verify the viability to incubate Guajolote eggs in the Coastal region of Oaxaca, México

Frequently the backyard producers take advantage of the female guajolote’s ability to incubate eggs, introducing in her nest the eggs from other birds, mainly from hens (56.3%) or even wild birds such as the chachalaca (*Ortalis sp.*) or the pijiji ducks (*Dendrocygna sp.*) (1.1%); the balance of the producers do not do it.

An important criterion in determining the sale price of guajolotes is their sex, with males more valued due to their larger weight. Because of this, it is very important for the producers to know as early as possible the sex of the poult. Interviewed producers agree that during the early weeks of life it is very hard to determine the sex, with the more appropriate age to do it is 3.3 ± 2.56 months. From the total number of production units studied, 87.0% apply some sexing technique to the poult. These techniques are based on the faster rate of growth of the males when compared to the females, the development of secondary sexual characteristics and to the more aggressive and nervous temperament of the males (Table 9).

Table 9. Criteria used for the sexing of poult in the coastal region of Oaxaca, México

	Frequency	Percentage
Body development	248	32.3
Head development	133	17.3
Development of the snood	126	16.5
Vocalizations	53	6.9
Erection of feathers	45	5.9
Development of legs and tarsus	24	3.1
Development of caruncles	15	1.9
Beard development	13	1.7
Ethology	11	1.4
Don't know	100	13.0
Total	768	100

In the backyard breeding conditions studied, there is no clear criterion to select the breeding stock, usually the bigger and heavier guajolote sis selected to sell (Table 10), or when the producer consider that it is too old (frequently a male or hen with more than 2.5 years is considered too old for reproduction).

Table 10. Means of productive parameters in backyard guajolote breeding in the Coast of Oaxaca, Mexico.

	Male	SD	Female	SD
Average selling age ¹ (years)	1.2	± 0.5	1.2	± 0.5
Average selling weight ² (kg)	9.4	± 1.8	7.2	± 0.6
Total mortality ³ (%)	50	± 23.0	50	± 23.0

¹ Although the breeders point out that an older bird has more quality and taste better, it is infrequent to let them reach adult age.

² Final weight is very variable, due to the existing phenotypes in the zone, the feeding and the age of slaughtering.

³ It was considered any cause of death outside of the slaughtering.

Health

One characteristic of backyard aviculture is the limited sanitary control of the birds; as a result the incidence of epizootic outbreaks is frequent and the main cause of morbidity.

Due to the breeders' scarce economics resources and the backyard breeding of guajolotes in semi-scavenging conditions, the sanitary management is not adequate. Although 52% of the backyard guajolotes breeders declared they were using vaccines, they applied them without a proper calendar, mistakenly managing the vaccine cold chain and applying the vaccines inadequately since it is the breeder doing the vaccinations.

The type of vaccine more often applied in the Coast of Oaxaca is a triple vaccine, which provides antibodies against Newcastle Disease, Avian Cholera and Avian Salmonella. Some breeders sporadically apply Avian Pox vaccine. The average age when the birds are vaccinated is 7 months (± 3.56 SD) and the criteria of vaccination are the presence of some disease in the flock or in a nearby flock or the availability of some economics resources that can be invested in their birds.

Veterinarian services are not accessible to 39% of the breeders surveyed, so they give medication to their birds without prescription when they can afford it. Breeders use medication recommended by others breeders or by farm store clerks.

Among the most common medications used by the breeders are antibiotics, antimicrobial drugs, vitamins and antiseptics used by 5.9% of the breeders and internal and external parasite treatments which are used by 3.3% of the breeders.

Clinical signs of disease in guajolotes reported by the breeders vary and go from sudden death that is related to a serious illness, up to chronic disease signs like fever, weakness, diarrhea, cachexia, dyspnea and ataxia; with the last two being more frequently observed (Table 11).

Table 11. Clinical signs shown by sick guajolotes reported by breeders of the Coast of Oaxaca.

	Frequency	Percentage
Ataxia	227	29.5
Dyspnea	185	24.1
Anorexia and cachexia	164	21.3
Diarrhea	88	11.3
Emaciation	41	5.4
Drowsiness	28	3.6
Sudden death	15	2.0
Nervous disorder	12	1.6
Fever	8	1.1
Total	768	99.9

In some cases breeders reported the name of the disease instead of the clinical signs; this knowledge was obtained through sporadic visits by vets during zoo-sanitary government campaigns, the diseases are identified by the pathogenic lesions and in some cases by knowledge acquired by college graduates. These diseases are: Avian Pox (52.8%),

Newcastle Disease (46.3%), referred as “disease”, “plague” or “sadness” and Avian Cholera (0.9%).

The mortality index of guajolotes raised in backyard conditions in the Coast of Oaxaca is 50% (± 23.0). The age with a higher incidence of mortality is 3 months (± 2.3). Some cases are related to epizootic outbreaks, 91.1% of cases where males and females guajolotes are equally affected, 4.7% females and 4.1% males. The higher mortality of 36.9% and 32.5% respectively is related to hot and rainy seasons.

Since in the Coastal Region of Oaxaca there exist five ethnic groups and three of them are natives, the farmers maintain very strong traditions in customs and Pre-Hispanic knowledge of the settlers in this region; these circumstances together with the poverty and isolation of the communities prevent their access to veterinary services. As a result is very frequent the use of ethno-veterinary medicine, based on the use of plants and animal products that have been enhanced with modern products. Some pathological signs like fever, ataxia, pain, cutaneous lesions and inflammation are cured with vegetal, animal or varied products (Table 12).

Table No 12. Vegetal, animal and varied products use in ethno-veterinarian medicine for the treatment of pathological signs in backyard guajolote breeding.

Vegetal Product	Animal Product	Varied Product
Garlic (<i>Allium sativum</i>)	Armadillo shell (<i>Dasypus novemcinctus</i>)	Salt
Lime (<i>Citrus limonum</i>)	Coral snake meat (<i>Micrurus nigrocinctus zunilensis</i>)	Household Chlorine
Onion (<i>Allium linnaeus</i>)	Milk	Battery Electrolytes
Horse tail (<i>Equisetum fluviatile</i> L.)	Cow fat	Hot iron
Cahustle (<i>Parmentiera aculeata</i>)	Rattlesnake meat (<i>Crotalus aquiles</i>)	Gunpowder
Cuachalalate (<i>Ampbypteryngium adstingens</i>)	Lard	Cigarette ashes
Parota Bark (<i>Cedrela odorata</i> L.)		Vegetal oil
Ruda (<i>Ruta graveolens</i>)		Damp Cloth
Rosewood (<i>Convolvulus florudus</i>)		
Stream herb (<i>Dorstenia contajerva</i> L.)		
Aloe (<i>Aloe vera</i>)		
Epazote (<i>Chenopodium ambrosoides</i>)		
Rosewood (<i>Convolvulus florudus</i>)		
Copal Tree Bark (<i>Bursera sp.</i>)		
Mangle Bark (<i>Rhizophora mangle</i> .)		
Epazote Skunk (<i>Teloxys graveolens</i>)		
Chilacayota (<i>Cucúrbita ficifolia</i>)		
Tecamasuche Stick (<i>Pachira acuática</i>)		
Berry Herb (<i>Smilax aristolochiifolia</i>)		
Rosewood (<i>Convolvulus florudus</i>)		
Quina Tree (<i>Cinchona succirubra</i>)		
Tomato (<i>Solanum lycopersicum</i>)		
Orange Blossom (<i>Citrus limonum</i>)		

Sale price and production costs

The estimation of the backyard guajolote production cost is difficult because neither feed intake nor direct and indirect expenses are recorded by the breeders. Furthermore labor is not treated as a cost and the sale price always fluctuates and depends more on the urgency to sell the bird than other financial considerations. Frequently the guajolotes are fed with maize that usually comes from the breeders' fields.

The guajolote's sale price is also determined by the time of the year. The guajolote demand and price increases during weeks close to important community celebrations in the coast of Oaxaca. The high seasons for the guajolotes are June and July when the celebrations for the graduation of youngsters are taking place; November, due to the celebration of the all souls day (*dia de los muertos*) and December with the Christmas celebration. During these months prices could be increased 250%.

The trade of poult and eggs is very limited; frequently they are only sold to acquaintances. The eggs for incubation are sold fresh and just the poult that are three months old or more, so they could be sexed in order to be priced better. The males are more expensive than the females due to the profitability in carcass. The females are destined to the production of fertile eggs.

The estimation of the backyard guajolote production cost was done considering: the poult sale price in the breeder's community (\$7.1 US dollar), the daily intake of feed (in kg), breeding time (in days), the price per kg of maize in the community (\$0.5 US dollar), the application of just one vaccine during the breeding cycle (\$1.0 US dollar). The labor cost was estimated through the calculation of one hour of labor per week at \$0.54 US dollar per hour, considering the minimal wage in Mexico and the average age of the birds for consumption (in weeks). Due to the almost complete lack of installations and related equipment, they were not considered when calculating costs. The formula to estimate the production cost is as follow:

$$PC = PSP + (DIF*FP*BT) + VC + (HLC*BT)$$

where:

PC = Production Cost
PSP = Poult Sale Price
DIF = Daily Intake of Feed
FP = Feed price
BT = Breeding Time
VC = Vaccine Cost
HLC = Hourly Labor Cost

Using the formula described, the production cost of the male guajolote was \$105.9 USD and of the female was \$104.4 USD; using the average sales price, there is a deficit of \$74.6 and \$93.0 USD when selling male and female birds respectively (Table 13).

Table 13. Means of sale price of the guajolote and their eggs in the Coastal region of Oaxaca, Mexico.

	Mean	SD
Adult male	\$ 31.3 USD	± 10.9
Adult female	\$ 19.4 USD	± 9.0
Poults	\$ 7.1 USD	± 2.8
Eggs	\$ 0.25 USD	± 0.14

Destination of the production

The backyard guajolote production is mainly for the breeders' self consumption and this reflects their socioeconomic situation, and as such they will occasionally sell a bird when an urgent economic need presents itself. The breeders offer their guajolotes to the neighbors, in farm markets or they go to the main towns in their region in order to sell them, but with some disadvantage in relation with livestock produced with technological and semi-technological systems coming from other states. The travel expenses incurred in the sale of the birds are rarely recovered so they are often absorbed by the breeders. Frequently the breeders travel to the state capital in order to get breeding stock, usually a trip of more than three hours, making possible the birds' genetic exchange but increasing their cost.

In rural communities it is a tradition to give as a wedding present a pair of guajolotes, so the newlyweds can start their own poultry breeding simultaneously with the beginning of a new family unit. They are also given as presents to thank godparents in weddings and baptisms. Figure 4 shows the destination of the backyard guajolote production in the Coast of Oaxaca.

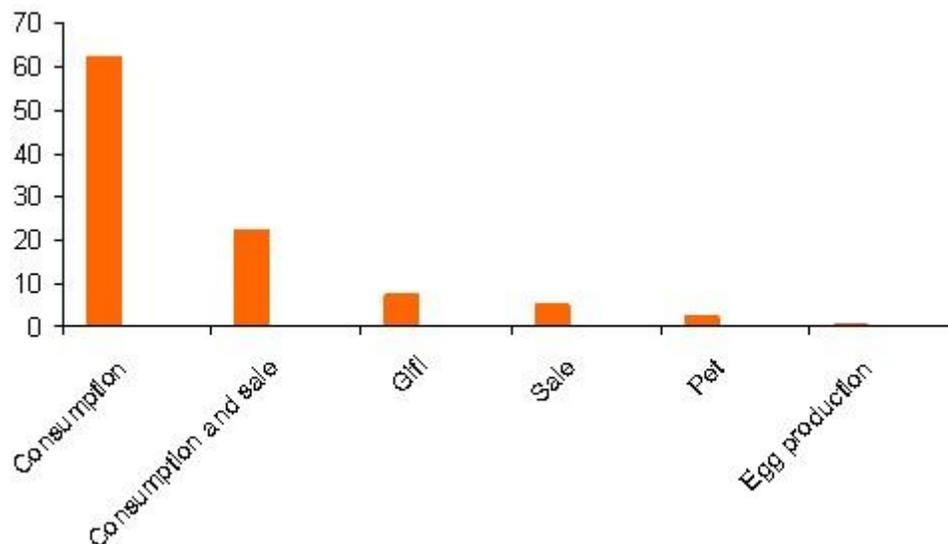


Figure 4. Destination of the backyard guajolote production in the Coast of Oaxaca, Mexico

The principal use of the guajolote's egg production is for incubation (80.7%), due to the traditional preference for the chicken's eggs flavor over the guajolote's, 14.9% of the breeders use the eggs for self consumption and just 4.4% sell them.

The backyard guajolote production is mainly oriented to obtain meat which is highly prized for special celebrations. Its most worthy characteristics are the taste of the meat and their higher weight in relation with the creole hen or the broiler chicken. Eighty-nine % (frequency of 684) of the breeders surveyed like to consume guajolote because of: the taste of the meat; the birds are hygienic when bred in households; the amount of meat obtained of each bird and because of tradition.

Discussion

The native and creole backyard breeders in Central America have mainly black or bronze guajolotes, but reported the presence of red, yellow, grey and other varieties of colors and combinations Mallia (1999). Apparently, the unusual color varieties that are present in the Mexican backyard breeding come from gene combinations of guajolote populations with different grades of reproductive and genetic isolation (Sponenberg et al 2005). Mallia (1998) carried out a study with backyard guajolotes in the states of Oaxaca and Quintana Roo, Mexico, and described the feather's coloration in pure black, yellow and white colors without a metallic tint in the plumage, as well as combinations of brown, white and black. In addition it was reported that in the state of Oaxaca close to the 40% of the guajolotes are black, between 35 to 40% are brown and 20 to 25% are white, yellowish or mixed. In the state of Veracruz, Mexico, Aquino et al (2003) reported the prevalence (75.9%) of guajolotes with two or more colors, followed by black, white and brown reddish colors. In the year 2000 The American Livestock Breeds Conservancy and The Society for the Preservation of Poultry Antiquities compiled the census data of the domestic turkey in the United States of America and reported 22 breeds of turkeys with different phenotypes, all these breeds were considered rare (Sponenberg et al 2000).

Almost half of the backyard breeders in the coast of Oaxaca use pens or some type of construction designed to hold their fowl; the rest lets them roam free, or tied by one leg or in small individual cages. This information is consistent with the report from Camacho-Escobar et al (2006) for backyard aviculture breeding. In spite of the knowledge of the advantages that some type of installations provides, they prefer not to keep their fowl in them, mainly to take advantage of the scavenging instincts of the guajolotes to reduce the feeding costs.

In the United States of America, The National Academy of Sciences (1991) indicates that the ability to scavenge of guajolotes, results in it being a fowl with the greatest potential for raising under such conditions; however, these characteristic are neither well known nor studied in Mexico. Nevertheless, these characteristics are taken advantage of by some backyard breeders. Piña (1983) reports that guajolotes bred in semi-scavenging conditions show less feed intake and better feed conversion than guajolotes bred under intense conditions. These results have been confirmed by Parkhurts and Mounthey (1987). In an

experiment with six months old guajolotes, without genetic characterization and kept 70 d in confinement and fed with concentrate feed, Calderón et al (2002) reported that the daily gain in weight was 47 g, the overall weight gain during the experiment was 2.4 kg, the daily feed intake per bird was 308 g and the overall intake during the experiment was 21.5 kg; with a feed conversion of 8.4. However, the daily weight gain reported is inconsistent with the increase of weight that the guajolotes should have had during the experiment. Lugo (1975) reported feed conversion index feed-flesh of 3.3:1 and 3.5:1 for males and females respectively. Díaz (1976) reported of feed conversion of 2.8 to 3.2 in selected strains in Mexico. Under industrial conditions it has been reported feed conversion indexes of 3.58 (Galván 1975).

Mallia (1999) reported that in Guatemala and Honduras the average weight of male guajolotes is between 11 and 13 kg and for females between 5.9 and 7.2 kg and that mortality in a flock could be total due to disease outbreaks. The National Academy of Sciences (1991) in a description of the “Creole turkey” from Mexico pointed out that their maximum size is less than the half of the size of improved breeds. The male weight is between 5 to 8 kg and the female is between 3 to 4 kg. With this reference the weight reported is lower than the findings in this study. The backyard guajolotes selling weight in the states of Oaxaca and Quintana Roo, is between 5.5 to 7.4 kg for females and between 6.9 to 9.2 kg for males, although they are able to reach weights between 11.5 to 12.9 kg (Mallia 1998).

Creole guajolotes show a seasonal reproductive behavior; which occurs during the long days (from April to June); reaching their sexual maturity between six to nine months of age and in tropical regions could lay more than 20 small eggs (National Academic of Science 1991). It is possible that the native guajolotes in Mexico and United States of America have long laying periods, consequently they could get, as wild turkeys do, 10 to 25 eggs before the guajolote hen incubates them (Sharp 1989). Mallia (1998; 1999) reported that the ratio male : female is of 1:3-5 in backyard guajolotes; similar information was obtained in this study. Ramos (1966) reported that for the Giant Bronze strain, bred in the Valley of Mexico, the incubability rate is 42.1% and 76.4% for fertility; while for the Beltsville strain is 50.5% and 74.3% respectively. Juárez-Caratachea y Ortiz (2001) in a study about incubation rates in backyard birds reported an overall fertility of 82.4% and a hatchability of 60.7%.

Mallia (1998) reported that when 5 – 12 months old poults are raised with other fowls the mortality could be from 50 to 100%. In this study the high mortality was related to hot and rainy seasons. Similar results have been reported by backyard breeders in the Central region of Oaxaca, Mexico, where the season with most diseases is summer, with high temperatures and rain (Jerez et al 1994). Confined production systems were compared with scavenging systems by Galicia et al (2001), reporting lower mortality in guajolotes raised by scavenging.

In the Central Valley of Oaxaca, Mexico, the most common diseases in the backyard production units are respiratory syndromes, Avian Pox, and Newcastle Disease (Jerez et al 1994). The incidence of Avian Pox in backyard rearing is high; Farooq et al (2002) reported similar findings. Because of the observations made in Mexico and Central America, Mallia

(1998, 1999) assumed that the backyard breeding of guajolotes and hens in these regions could be very sensitive to infectious diseases by *Histomonas meleagridis* and *Heterakis gallinae* causing a high mortality. In Cuba with same conditions, it was determined that the poor diet in poultry flocks increased the susceptibility to respiratory infections, Avian Cholera, Entero-bacteriosis, intestinal helminthiasis and coccidiosis (Pérez and Polanco 2003).

Due to their habits, Hulet et al (2004) identified different seasons for the turkey consumption, in Christmas for Europe and thanksgiving celebration for the United States of America. This situation made the turkey production to be seasonal. In Mexico generally in urban zones guajolotes are consumed for Christmas and New Year celebrations, in rural zones they are consumed for special celebrations and in the south of the country they are consumed on a regular basis (Díaz 1976).

Commonly the guajolotes are traded as livestock at the production site or eventually in markets of nearby cities; Lugo (1975) reported the sale price of guajolote at \$2.3 USD, close to the sale price reported in the present study. Azharul et al (2005) reported that the production cost mainly depends on the feed price. In the present study, the feed price could be overestimated because frequently the producers use their own grain harvest to feed the birds. The cost was estimated with the retail sell price of maize found in the community; besides the producers have the tendency to exaggerate the intake of the feed and the final price of the birds. In general the estimation of production costs are complicated because of the various factors to be considered and because of the fluctuation of prices (Hulet et al 2004). Missohou et al (2002) reported that in the rural poultry production system of Senegal, where the birds are not fed and they find their own food through scavenging, with scarce vaccination and installations, the production costs are very low, almost non-existent; however, neither labor nor mortality are considered in the sale price.

Bixler (1968) compared and reported that the feeding cost of the guajolotes raised through scavenging is lower than the one for birds fed with concentrate. The difference was 28% less per kg of turkey flesh and 34% less per bird fed through scavenging versus those fed with concentrated grain. Galicia et al (2001) compared the scavenging guajolote production with confined production and reported that the production cost for the scavenging system is 3.5% higher than the confined system. However, when the benefit/cost analysis is done, the profits obtained with scavenging guajolotes are 55% higher than of the confined guajolote system. Piña (1993) compared the breeding of 1,000 white and bronze guajolotes in confinement with semi-scavenging and reported that guajolotes in semi-scavenging conditions produced 1,864 kg more meat than the confined guajolotes with a lower production cost of \$0.63 USD and an increase of \$5.6 USD per bird sold. Similar results were reported by Parkhurst and Mountney (1987) and were confirmed by Mbanasor and Sampson (2004). They carried out an analysis of the socioeconomic determinants in the guajolote production among soldiers in Nigeria and concluded that the backyard breeding system is viable as a productive enterprise. Cuca y Ávila (1980) estimated that the profit per guajolote, bred in semi-scavenging conditions was \$12.5 USD.

In the Central Valleys of Oaxaca, Mexico, Jerez et al (1994) reported that the production is almost exclusive for consumption with or without an occasional sale, whereas the backyard

breeders of the Yucatan, Mexico, destined more than 63% of the production to the livestock sale in their own towns (Rejón et al 1996). Camacho-Escobar et al (2006) reported that 68% of the backyard livestock in the Coast of Oaxaca is destined for consumption, 18% to the occasional sale, 11% only for sale and 1% for presents or gambling. Due to the slow growth and the high mortality of the birds, the utilization of the guajolotes' backyard production units is very low. Aquino et al (2003) estimated that the number of guajolotes sold was only 20 birds during one year in three towns of the state of Veracruz, Mexico.

Conclusions

- The breeding of backyard guajolotes in the Coast of Oaxaca is a traditional activity, which is kept mainly in the homes of small scale farmers and low income people, in small production units with a variety of domestic animals and together with chickens which are the domestic species more common among producers.
- A great variety of phenotypes exist in creole guajolotes, which have not been adequately studied and their genetics relations and productive parameters are unknown.
- A type of pen is utilized for the guajolotes to stay the night; however, they are freed during the day for the purpose of feeding and for this reason the breeders have developed various techniques to identify their birds to avoid losing them.
- The guajolote is a species that has good acceptance mainly because of its taste and the profitability in carcass; but it is necessary to reduce feeding costs and improve reproduction in order to get a profitable production.

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