

Carcass analysis of four quails species in Mexico State

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Abstract: The human diet consists of a great diversity of foods in where the most common source of protein comes from animals; mainly from fattening species of pigs, beef, chickens, and sheep due to intensive farming high fat content. The current study was aimed to evaluate the meat analysis of four species of wild quail breasts: Common quail, Banded quail, scaled or Squamous quail and Montezuma quail. Quails were collected from March to June, in the State of Mexico. The findings showed that of the studied species, the meat of *Moctezuma* had the greatest amount of protein (26.99%DM); however, the lowest fat content (1.25%DM) was with *Squamos*. Up to the time of this investigation, no data existed on the nutritional qualities of meat coming from these wild species in the State of Mexico. As we now know, this meat has better attributes, compared even to rabbit meat and to the meat of other domestic species that are consumed on a daily basis. It was concluded that the carcasses protein and dry matter contents were similar with all studied species where fat content of the *Callipepla squamata* had the highest value.

[Mariezcurrena MA, Zimbron SI, Domínguez Vara I, Vázquez Guadarrama MC, Salem AZM, Mendoza Martínez GD, Mariezcurrena Berasain MD. **Carcass analysis of some quails species in Mexico State.** *Life Sci J* 2014;11(6):202-206]. (ISSN:1097-8135). <http://www.lifesciencesite.com>. 27

Keywords: Quail; nutrition; carcass analysis; meat quality.

1. Introduction

The quail is a wild bird (*Coturnix genus*) which originated in Africa, Asia and Europe. Just as the partridge and the pheasant, it belongs to the Phasianidae family. The most extended subspecies are the European quail (*C. coturnix coturnix*) and the Japanese quail (*C. coturnix japonica*). The first one is a wild bird, with seasonal laying capacity, and bigger growing potential with better hunting skills; the second is a domestic bird, more adequate for intensive production due to its qualities as a layer and its greater potential for growth. There are also some quails that have an American origin, such as the "Bobwhite quail" (*Colinus virginianus*) which it does not belong to the *Coturnix* genus (Marks, 1993). In general, the wild quails are small birds that are mainly found among the seed crops and along the sides of paths, and whose presence usually goes unnoticed, except when they are surprised by people and then fly away hurriedly and in all directions. Quails do not have a prolonged flight. They are monogamous birds that come together in groups at night or when there's bad weather and in order to feel protected they stand in a circle with their heads turned outwards (Du Preez and Sales, 1997).

In a limited spaces and resources world, the advantage of making use of the wild quail becomes obvious when we learn about its resistance to diseases and parasites, and its adaptability to different

climates and, in addition, the fact that it is an excellent food for humans. This is due to the quality and quantity of protein and vitamins in the meat of these animals, as well as the fat content (approximately 6.0%), which makes it an appreciated meat because of its juiciness and flavor, among other things (Gordillo, 1998; Marks, 1993). For this reason, and since it is a wild animal, it's important to respect the closed seasons, in order to not cause an imbalance in this species (Gordillo, 1998).

In the State of Mexico, quails have been found in transition zones between grasslands and pine-oak forests (Tapia *et al.*, 2002). Previous studies have shown that, depending on the season, wild quail may feed on tubers, seeds of leguminous plants and grasses, acorns and insects (Brown, 1978; Stromberg, 2000). Recent studies carried out in the State of Mexico on population density (Tapia *et al.*, 2002) and habitat of the Montezuma quail (Zaragoza *et al.*, 2001) show that it is not at a critical level to be considered a species in danger of extinction (Abarca, 1998); however, the information on this species' diet is scarce. The objective of this work was to evaluate and compare nutritional characteristics, specially with respect to protein, fat and dry matter, of four wild quail species: common quail (*Colinus virginianus*), banded quail (*Philortyx fasciatus*), scaled or squamous quail (*Callipepla squamata*) and Montezuma quail (*Cyrtonix moctezumae*), which live

conditions in the State of Mexico. This is the first study of this type, using different bird species as the object of the current study, which were collected in this State.

2. Material and Methods

The current experiment is a part of the provisory experiment published by Hernández-Téllez *et al.* (2004). Three wild females quails with a live weight between 150 and 200 g were obtained from each of the four species from the State of Mexico. The species were: common, banded, scaled and Montezuma quail. These individuals were donated by inhabitants of different municipalities in the State of Mexico (Aculco, Oztolotepec, San Felipe del Progreso and Polotitlan). This material was frozen completely at -4 °C. Later on, they were defrosted, eviscerated, and the breast was separated from each one of the animals; this was divided into two parts, with which the research was carried out. For the nutritional evaluation, three elements were considered to be the most relevant for the study: fat, protein and dry matter. The analyses were performed according to AOAC (2010) norms, for protein: 938.18, for fat: ASN 3106 and for dry matter: 950.46.

The results were statistically analyzed using variance analysis, where the four quail species were evaluated, with three repetitions per specie. Scheffé test was applied to compare means.

3. Results

Protein content was not affected ($P > 0.05$) among the wild quail varieties (Table 1). However, the highest mean was for *C. m.* with 26.99%, followed by *P. f.* with 26.27%, and then by *C. sq.* with 26.15%; the lowest was *C. v.* with 25.95%. Fat content was different ($P < 0.05$) in the wild quail varieties, for which a Scheffé test for the comparison of means was applied. The test indicated that two statistically different groups had been found. In the first group with the highest mean, was *Callipepla squamata*, with a mean value of 3.38% for fat, where the second group, with lower mean values, were *C. v.*, *C. m.* and *P. f.*, with fat values of 1.53%, 1.33% and 1.25%, respectively.

Dry matter was not affected ($P > 0.05$) also among the wild quail varieties. However, the highest mean was for *C. sq.* with a value of 29.9%, followed by *C. m.* with 28.9%, *C. v.* in the third place, with 27.9% and the lowest with 27.8% for *Ph. f.* As it was mentioned above, similar studies with this used to compare with our results, at least for wild quail of the Americas/American wild quail were made. For this reason, this study was based on information on domestic species such as pigs, sheep, rabbit and domestic quail, among others, which have a high *per capita* consumption in society (Table 2).

Table 1. Carcass weight, protein, fat and dry matter (\pm SD) concentrations of different wild quails species (on dry matter bases).

Species	Carcass weight (g)	Protein (%)	Fat (%)	Dry matter (%)
<i>Colinus virginianus</i>	160	25.95 \pm 0.01	1.53 ^b \pm 0.02	27.9 \pm 0.01
<i>Phylortyx fasciatus</i>	124	26.27 \pm 0.02	1.25 ^b \pm 0.01	27.8 \pm 0.02
<i>Callipepla squamata</i>	172	26.15 \pm 0.01	3.38 ^a \pm 0.03	29.9 \pm 0.01
<i>Cyrtonix moctezumae</i>	175	26.99 \pm 0.02	1.33 ^b \pm 0.02	28.9 \pm 0.02

^{a,b} Means with different superscript in a column, are statistically different (Scheffé, $P \leq 0.05$).

Table 2. Carcass weight, protein, fat and dry matter (\pm SD) concentrations in meat of pig, sheep, rabbit, chicken, as well as hen's egg and domestic quail¹

Species	Carcass weight (kg)	Protein (%)	Fat (%)	Dry matter (%)
Pig	80.0	12-16	30-35	47-48
Sheep	30.0	11-16	20-25	37-38
Rabbit	1.0	19-25	3-8	30-31
Chicken	1.4	12-18	9-10	33-34
Domestic quail	0.160	12-14	1-2	36-38

¹Adapted from Kumosinski and Farell (1994).

4. Discussions

Compared to results to rabbit meat, which was the one with the highest content of protein (19.0-25.0%), and the lowest in fat (3.0-8.0%), the meat of the Montezuma quail, had a protein content (26.99%) that was higher than that of rabbit, and it also had a lower fat content (1.33%). For other types of meat, the results point to an amount of protein that was up to 2.0% over the amount in rabbit meat, 9.0% higher than that of chicken and egg, and 11.0% more than pork and rabbit. The results on protein content that were obtained in our work (25.95-26.99%) were constant with those of Mohan *et al.* (1990) and Shrivastav *et al.* (1994), who also stated that there were influencing factors in nutritional composition of each bird. Factors, such as genetics, food, season, habitat, climate and age, among others, make the percentage of protein and fat vary from one animal to another.

Bishop and Hungerford (1965) stated that in winter, the Montezuma quail mainly feeds on tubercules such as *Oxalis divergens* and *Cyperus* spp. and, as has been reported by some authors. The nutritional composition of fresh tubercules was at least 14.0% carbohydrates, a situation that could promote an increase in the percentage of this nutrient in quail meat and a decrease in fat or protein (Bishop and Hungerford, 1965; Mohan *et al.*, 1990; Hernández *et al.*, 2005; Zaragoza *et al.*, 2001; Romero, 2003).

The samples used in this work were collected in the State of Mexico, in different habitats with a diversity of ecosystems, such as pine-oak, cultivated zones (corn, wheat and potato) and grazing areas near the forest, as well as deforested mountain regions where secondary shrubs or weeds are beginning to grow around lakes and on the edges of rivers. Leopold and McCabe (1957) showed that these ideal environments for these quail species. Also, Leopold and McCabe (1957); Bishop and Hungerford (1965) and Stromberg (2000) mentioned that these birds' diets, mainly during the rainy season, were based on insects, since the soil during this time had more humidity and thus, more food for insects, as well as ideal conditions for their reproduction. Probably due to a greater number of insects, this became the basic diet for the young birds. Some studies carried out in Europe, including Edwards *et al.* (1981); Murakami *et al.* (1993); and Shim *et al.* (1981), established a single protein level for the mature japonica quail between 20.0 y 26.0%; however, the purpose of rearing the domestic quails in European countries was to be fattened for gourmet cooking. These birds were fed with diets of grains, mainly wheat, corn, soy, among others, and sometimes sunflower is added to the diet.

Protein concentration was at the same levels (25-27%) as those reported by other authors for domestic animals. With respect to the analysis of fat content, the species that showed statistically significant differences was *C. sq.* (squamous quail), since it had the highest level (3.38%) with respect to the other three species. This differs from Barrios and Marín (2007) who reported that according to the type of food and its composition, this species should have the lowest fat content of all the studied species. On the other hand, the squamous quail had the highest percentage of fat of the four evaluated species, although it showed a lower content with respect to rabbit meat, which has the least amount (3.0-8.0%) of all species reported in our previous table (Table 2). This suggests that quail meat was an excellent option for human consumption. Reinforcing the previous idea, Clarence *et al.* (1979) mentioned that grains from cereals were the best source of energy and are commonly the major part of birds' rations (Cardoso *et al.*, 2011). Among the grains that were generally used for domestic birds were corn, oats, wheat and barley. Sorghum, buckwheat and rye are used in some regions. Yellow corn (*Zea mays*), was one of the best feed grains for birds, since it had a high content of digestible nutrient, low content of raw fibers and has more lipids than other grains, except oats. Clarence *et al.* (1979) also mentioned that during the spring-summer cycle, bird consumption of insects, for which it was evident that the concentration of protein in their food was greater, and there had less amounts of carcasses fat. This was also related to the low consumption of grains, which were the ones that supply fat in the birds' diet.

It was noted during the samples collection (March-June), grains were a secondary element in the diet. In the case of fat contents that needs to be highlighted with some studies, such as Edwards *et al.* (1981); Murakami *et al.*, (1993) and Shim *et al.*, (1981), who found that carcasses fat was ranged from 17.0 to 19.0% for the domestic quail. These values were very different from the our results, which ranged from 3.0 to 8.0% for the wild quail. This situation could be explained by the physical activity carried out by both animals, since domestic animals were placed in closed spaces, for the purpose of fattening, with standard water and food, thus avoiding the need for any kind of movement, such as flying. Thus, the birds cannot eliminate fat in a natural way. The situation for wild birds was the opposite, since they move over large expansions of territory searching for food and shelter. Thus, they use up their fat reserves on a daily basis and favor the development of muscle during their activities.

Regarding to the meat and water retention that play an important roles, one of the main

properties of meat was intimately related to their juiciness. This was the impression that the chewing and its function, the juice liberated from meat and by saliva secretion, basically stimulated by fats (Potter, 1978; Chinachoti, 2000). It was also related to softness of the meat, which depends on the texture of the muscular tissue and the initial ease with which the meat was cut into pieces, as well as the importance of remains role flavors after chewing (Potter, 1978; Damodaran, 1994).

There were several factors influencing water retention; some of them the protein and salt concentrations, the degree of denaturalization of proteins and the presence of low molecular weight compounds, such as sugars or alcohols (Chinachoti, 2000; Kumosinski and Farell, 1994). Edwards *et al.* (1981); Murakami *et al.* (1993); and Shim *et al.* (1981) established a level of water content for the mature japonica domestic quail, going from 55.0 to 65.0%. The results that were obtained in the current work showed that the concentration of water was quite a bit higher, being 81.9%, as shown in Table 2. In the current study, it was related to percentage of protein (25.95-26.99%), increased the protein and water percentages and lowered the fat content. This fact was shown in the Montezuma quail, which had the highest protein percentage (26.99%) water content (82.1%) and the lowest fat content (1.33%) of all studied species.

Conclusions

The meat of wild quails is an excellent food option due to its nutritional attributes, specifically its high protein content, which ranged from 25.95 to 26.99%. This percentage, as well as the dry matter (27.9 to 28.9%) was similar in all four studied species. Fat content, *C. sq.* had the highest value, with 3.38%, the highest of the four species, that content could be related to the type of diet elements intake, although some were grasses and basic fodders.

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3/30/2014