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Social strategies associated with identity profiles in dairy goats

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ABSTRACT

The aim of this study was to identify and analyse the social strategies associated with dominance, conflict resolution, individual behaviour and morphological traits in goats. Social interactions of 30 high-yielding dairy goats were recorded over a period of 16 days for 96 h. The variables measured were social interactions, conflict resolution, individual behaviours and morphological characteristics. Using seven variables of social interactions, through the test of factor analysis three factors were obtained that concentrated the 92.3% of the variance. These were labelled as 'avoider' factor (36.9%), 'no-agonistic' factor (28.1%) and 'agonistic' factor (27.3%). Subsequently a hierarchical cluster analysis was performed in order to identify identity profiles (groups of similar animals) which could help to explain the possible association between social strategies (obtained from the factor analysis) and index of success, conflict resolution, social and individual behaviour and morphometric characteristics. Social strategies, dominance, conflict resolution, and the time they devote to feeding and resting, beard length, thoracic circumference and the particular association of each one of these characteristics has allowed us to identify four types of identity profiles which we have termed aggressive, affiliative, passive, and avoiders. Our results show the existence of an association between social strategies with identity profiles in dairy goats. We propose the use of term identity profile for describe individuality, personality and their relationship with certain morphological traits of the animals.

1. Introduction

The social group is part of the complex, dynamic environment of the individual, in which many strategies have evolved to enhance survival and maintain the viability of the group (Miranda-de la Lama and Mattiello, 2010). In the wild, goats live in sexually segregated flocks, except in geographical areas where breeding occurs year-round (Shackleton and Shank, 1984). The females typically live in small, stable groups and during the breeding season, males join the female groups and compete for access to the females (Shank, 1972). A largely stable relationship of matriarchal dominance exists between group members, maintained through affiliative and aggressive interactions (Fournier and Festa-Bianchet, 1995). However, in intensive dairy production systems goats are housed in barns in conditions that differ substantially from the natural habitat of the species with respect to limitation of space and resources, such as resting or feeding places, as well as

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the composition and size of the herd (Aschwanden et al., 2008, 2009). Under these conditions, social relationships also imply competition and conflict of interest (Aureli et al., 2002). Particularly in groups with stable social structures, an increase in conflicts of interest may cause aggression and jeopardize future cooperation (De Waal, 1986). To preserve cooperation, group-living animals use behavioural resolution mechanisms that mitigate conflicts, prevent aggressive escalation and resolve disputes; and should therefore be strongly selected characteristics in animals living in stable social organizations (De Waal, 2000). As a consequence, individuals are forced to build adequate behavioural strategies to respond to the social challenges posed.

Individual differences in animal behaviour are the rule rather than an exception (Bekoff, 1977). In recent years, numerous studies have revealed wide behavioural variability displayed by individuals of the same species, even of the same breed and reared under the same conditions (Boissy and Bouissou, 1995). Such individual differences in behaviour and physiology have been explained by underlying personality traits, styles or strategies (Mülleder et al., 2003). These concepts can help us to understand individual behavioural differences and to predict the behaviour of animals. Strategy can be defined as a behaviour or collection of behaviour patterns, which an individual uses to achieve a goal (Mendl and Deag, 1995). Behavioural strategies reflect different categories within a personality trait. Hence, personality presumably represents an important, underlying factor for each behavioural strategy (Erhard et al., 1999). If personality differences evolve jointly with morphology and other traits (Briefer and McElligott, 2011), they can facilitate speciation and the conservation of adaptive change (Wilson, 1998). Personality and identity are constituted and characterized by the interplay of their genotype and phenotype (Dingemanse et al., 2009; Stanghellini and Rosfort, 2010). In the present study we use the umbrella term "identity profile" to describe individuality, personality and their relationship with morphological traits of the animals. However, less is known about social strategies and their association with the identity profiles (behavioural and morphological traits) in goats. To gain an understanding of social strategies in dairy goats is thus of major importance, not only from an evolutionary perspective but also in relation to practical situations such as in dairy production. Insight into this individuality can be used to carry out recommendations on changes in herd handling aimed at improving social cohesion and achieving more efficient management procedures in goat herds. The aim of this study was to identify and analyse the social strategies associated with dominance, conflict resolution, individual behaviour and morphological traits in dairy goats.

2. Materials and methods

The study was carried out in the Tlaxcala State (central Mexico plateau) from September to December 2004, on a commercial farm located in Huamantla, Tlaxcala state (latitude 18°19_N), at more than 2153 m above sea level, with a mean temperature of 15.5 °C and a mean annual rainfall of 670 mm. The experimental protocol was first approved by the Internal Animal Ethics Committee of the Faculty of Veterinary Medicine (UNAM).

2.1. Subjects

Thirty Saanen high-yielding dairy goats (3.5–5 years of age, multiparous, dehorned) were used. The group was housed in a 25 m × 17 m pen (stocking density of 14 m^2 per goat) 80 days before the observations were carried out. The goats were fed twice a day, in the morning between 08.00 and 09.00 h and in the afternoon between 14.00 and 15.00 h. Good quality corn silage was offered in a lateral feeding passageway with a layout of the feeding trough that allowed individual feeding places (35 cm per animal) for all the goats in the group. The pen was equipped with a metallic water trough (1 m × 2 m), and a lick stone for minerals. The goats were milked at 15:00 h and were fed a standard concentrate pellet diet (approximately 0.3 kg per goat).

2.2. Behavioural observations and measurements

Direct observations, with a combination of scan and behaviour sampling, were carried out to collect information on individual and social behaviour, respectively. All goats selected were individually identified and marked with 30 cm-high numbers and letters painted on the sides and rump with washable spray for animal marking. A platform with a seat at 2.5 m above the ground was used to observe the goats from a distance. The goats were observed 6 h daily, from 8:00 to 10:00, 12:00 to 14:00, and 16:00 to 18:00 p.m. for sixteen consecutive days, making a total of 96 h of observations, always analysed by the same trained observer. The timetable for observations, in order to collect information on individual behaviour, consisted of observations at different times of each day so that, when averaged across the study, each part of the day was equally represented (Martin and Bateson, 1998). On each of the observation days a scan sampling was used every 10 min (576 samples) to obtain information on the total time spent lying down (goat resting with eyes open or closed); corporal care (goat involved in self grooming); feeding (goat with head inside the feeder trough); and walking (goat moving from one place to another). The proportion of time in those behaviours was calculated for each goat. For each goat the time spent in non-interactive behaviours during the study was expressed as proportion of time calculated as follows: number of observations of a behaviour/total number of scan samplings. The term time budget was defined as the summed proportions (total 100%) of these behaviours.

A behaviour sampling technique (Martin and Bateson, 1998) was used to record all social interactions (agonistic and no-agonistic behaviour). Agonistic interaction with contact included butts, which is when the goat used the front of her head to made contact with another goat and bit, which is when one goat bit another goat's body using her teeth. Agonistic interaction without contact included threats, when a goat turned towards or approached another individual with her head down and then lunged wit-

hout making contact; chase, when a goat actively moved towards another individual, causing the latter to walk or run away; and avoidance, when a goat actively moved away from another individual whether or not previous interaction had occurred between the two individuals. Non-agonistic interactions with contact included licking, when a goat passed her tongue over the body of another individual; grooming, when a goat groomed another goat's body using her teeth. Non-agonistic interactions without contact included sniffing, when a goat sniffed another goat's body and flehmen response, when a goat retracted the upper lip, wrinkled the nose and bared the gums in the presence of another goat.

For each animal the total number of times engaged in each of those social interactions was calculated. Indices of success were calculated using the data collected on interactive behaviours in order to reflect the social status of each goat according to her experiences in agonistic interactions with any other member of the herd. The index of each goat could therefore range from 0 to 1 and was calculated according to Mendl et al. (1992). Index of success = number of individual goats she is able to displace/(number of individual goats she is able to displace + number of individual goats able to displace her). The goats were then considered as in Barroso et al. (2000), Alvarez et al. (2003), Ungerfeld and Correa (2007) into three ranking categories according to their index of success (IS): low (IS = 0.0–0.33), medium (IS = 0.34–0.66) and high hierarchy (IS = 0.67–1.0).

2.3. Conflict resolution

One week after the first observations, goats were observed 6 h daily (8.00–10:00, 12:00–14:00, and 16:00–18:00) for eight consecutive days, making a total of 48 h of observations, always analysed by the same observer. Twenty five conflicts resolution were observed during these 8 days. Given that this behavioural phenomenon has been described in a general way by Tønnesen et al. (2008), and Miranda-de la Lama and Mattiello, 2010, we decided to carry out continuous behavioural sampling (Martin and Bateson, 1998), recording only those individuals who actively participated in conflicts. We used the term "mediator" to describe those individuals who interrupted a conflict by coming between the two conflicting animals. After the interruption of the conflict certain other individuals tended to perform non-agonistic behaviours (licking, grooming, sniffing and flehmen) with one of the contenders, and we termed them "supporters". The record of observations was focused on those that tried to intervene or support during the conflict. For the statistical analysis we only used the number of times that an individual intervened as a mediator or supporter.

2.4. Morphological measurements

Morphological traits were also estimated at the end of the last day of behavioural observations using an adapted measurement proposed by Traoré et al. (2008). The five body measurements obtained were: DE: distance between eyes; LB: length of beard; BL: body length; HW: height at withers; TC: thorax circumference (Fig. 1).

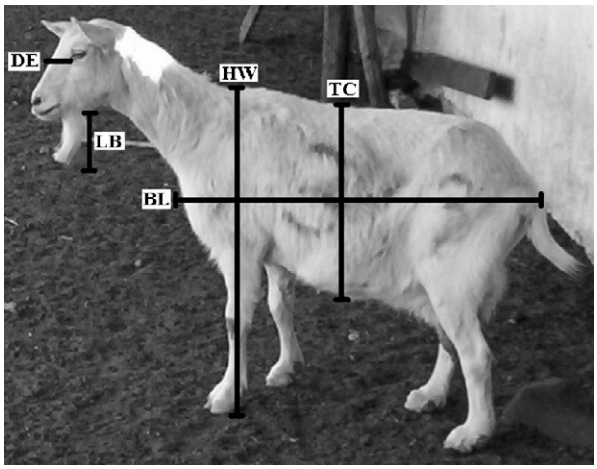

Fig. 1. Morphological variables studied and their reference points. DE: distance between eyes; LB: length of beard; BL: body length; HW: height at withers; TC: thorax circumference.

2.5. Statistical analysis

All statistical analyses were carried out with the software Package SPSS, Version 14.0. As an initial measurement, univariate analyses were carried out for all of the variables studied in order to understand individual behaviour and to detect atypical data.

2.5.1. Factor analysis

A factor analysis was used to summarise the data of seven social behavioural variables and to understand their correlational structure. Agonistic and non-agonistic behaviours were grouped in the following classes in order to analyse them:

No. of times each goat initiates an agonistic interaction with physical contact.
No. of times each goat initiates an agonistic interaction without physical contact.
No. of times each goat receives an agonistic interaction with physical contact.
No. of times each goat receives an agonistic interaction without physical contact.
No. of times each goat initiates a non-agonistic interaction with physical contact.
No. of times each goat receives a non-agonistic interaction with physical contact.
No. of times avoiding another goat.

The method of extracting factors used was that of principal components. The Kaiser–Meyer–Olkin index and Bartlett's test of sphericity were used as a measure of high correlation between variables. The factors selected were those that showed eigenvalues > 1. To gain a better understanding of the factors obtained, a Varimax method of orthogonal rotation was carried out. Accordingly, the factor scores in the analysis were estimated by means of the

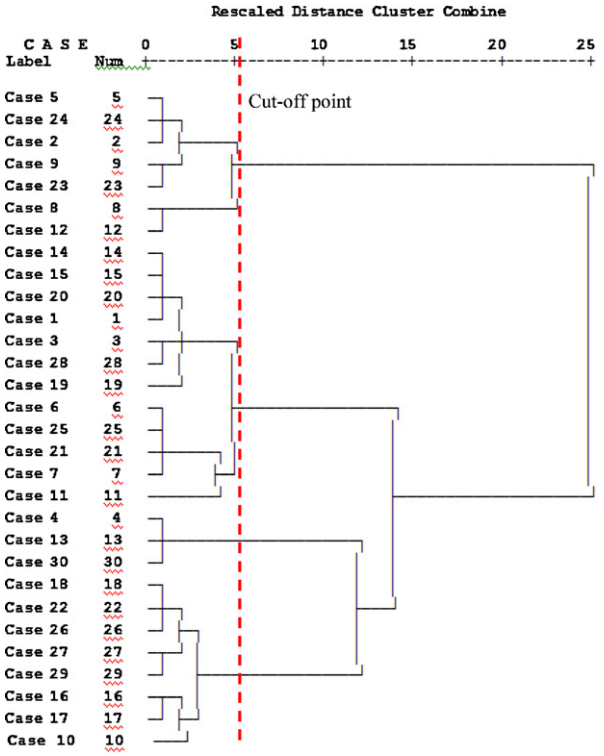

Fig. 2. Dendrogram – graphic solution of cluster analysis.

regression method and were consequently used to carry cluster analysis (Hair et al., 2005).

2.5.2. Cluster analysis

Subsequently a hierarchical cluster analysis was performed in order to identify differences in social interactions involvement. The cluster analysis enables segments of individuals to be identified, so that the characteristics of individuals that belong to the same group are as similar as possible, whilst, when compared with other groups, they are as different as possible. The distance used was the squared Euclidean distance and agglomeration was by the Ward method. The variables used to calculate the squared Euclidean distances were the scores of the three factors obtained and the two variables corresponding to conflict resolution. With the aim of reducing the effects of scale when forming the clusters, both groups of variables were standardized. The graphic solution employed was the dendrogram (Fig. 2). Once the membership to clusters variable had been created, they were then characterized using different variables such index of success, classes of behaviour (factorial scores), conflict resolution, individual behaviour variables and morphometric characteristics. To select the most significant variables that would enable differentiation between clusters obtained, a non-parametric Kruskal Wallis test and several non-parametric paired Mann Whitney tests were carried out, bearing in mind the characteristics of the study and the variables.

3. Results

3.1. Factor analysis

Three factors were extracted, explaining 92.3% of the variance. The parameters load high on these factors (Table 1). The first factor accounted for 36.9% of the total variance and was characterized by 3 of the 7 variables that were used: frequencies of agonistic receiver with physical contact, agonistic receiver without physical contact and active avoid. These variables had a very significant loading ($\geq$0.9). This factor indicated recipient behaviour, either agonistic behaviour and was labelled "avoidance factor". The second factor accounted for 28.1% of the total of variance and was characterized by 2 variables: frequencies of affiliative performer with physical contact and affiliative receiver with physical contact. These variables had a very significant loading ($\geq$0.9) and this factor was labelled as "no-agonistic factor". Factor three accounted for the remaining 27.3% of the total of variance. It was characterized by 2 variables, which had very significant loadings ($\geq$0.9): frequencies of agonistic performer with physical contact and agonistic performer without physical contact. Factor three was labelled "agonistic factor".

3.2. Cluster analysis

This multivariate analysis suggests the existence of four clusters or identity profiles that explain the association between social strategies and the variables studied (Table 2). The distribution of animals by strata is not homogeneous (cluster 1, groups together eight goats, cluster 2 three, cluster 3 ten and cluster 4 nine). All of the social variables obtained significant differences when they were compared between clusters. In the case of individual behaviours, only the feeding and resting variables were statistically significant. For the morphological characteristics, significant differences were only observed for length of beard and thorax circumference. Given the associations that were found in each cluster, 1 was termed "aggressive", 2 "affiliative", 3 "passive" and 4 "avoider".

The aggressive profile was characterized by individuals with high values for agonistic strategy, index of success (0.7), participation in conflict resolution and support of contenders. The number of times that they were observed feeding was lower (difference of −14%), compared to the avoider individuals who obtained the highest values of the study. For the rest variable, this profile rests fewer times (difference −10%) compared to the passive group, which was the group that devoted most time to this behaviour. They also had longer beards and greater thorax diameters than the goats in the passive group (difference of 12% and 5% respectively) and the avoider group (difference of 43% and 8% respectively). However, in comparison to the goats in the affiliative group, they had beards of a shorter length and less thorax diameter (difference of −6% and −2% respectively).

The affiliative profile comprised animals of average dominance (0.6), with high values towards the non-agonistic strategy. They also revealed scarce participation as mediators in conflicts, but a high presence as supporters

Table 1
Factorial analysis results – classes of behaviour in goats. Rotated component matrix.

Classes of behaviours	Factor 1 "Avoidance"	Factor 2 "Non-agonistic"	Factor 3 "Agonistic"
No. of times each goat receives an agonistic interaction with physical contact	**0.93**[a]	0.12	0.09
No. of times each goat receives an agonistic interaction without physical contact	**0.93**[a]	−0.18	−0.12
No. of times avoiding another goat	**0.90**[a]	−0.08	−0.34
No. of times each goat initiates a non-agonistic interaction with physical contact	−0.12	**0.96**[a]	0.11
No. of times each goat receives a non-agonistic interaction with physical contact	0.03	**0.96**[a]	0.17
No. of times each goat initiates an agonistic interaction without physical contact	−0.07	0.05	**0.95**[a]
No. of times each goat initiates an agonistic interaction with physical contact	−0.16	0.25	**0.91**[a]
Percentage of explained variance	**36.9%**	**28.1%**	**27.3%**

[a] Factor score coefficients are significant loadings of the variable on that factor (very significative loading ≥0.7).

of contenders. In relation to feeding and resting, they obtained values that were statistically similar to the individuals in the aggressive profile. Morphologically, they were the animals with the longest beards and largest thorax diameter of the whole study.

The passive profile group was formed by individuals with a low dominance (0.4) and with negative values in terms of the three social strategies. Although the negative value nearest to zero was the non-agonistic factor. They also revealed little participation as conflict mediators and a marginal presence in support of contenders. They were observed feeding fewer times (difference of −36%) in comparison to the avoider profile which, in turn, was the profile that obtained the highest values in the study in this respect. In relation to the resting variable, these were the individuals that devoted most time to this behaviour in the study. The mean beard length and thorax diameter was lower than that of the aggressive and affiliative profiles but higher than that of the avoider profile.

Finally, the avoider profile was formed by individuals with a low level of dominance (0.4), with high values in terms of the so-called avoider strategy factor and with

Table 2
Characterization of clusters obtained from dominance, classes of behaviour, conflict mediation, individual behaviour and morphological traits.

Variables	Individual characteristics				*P*
	Aggressive (*n* = 8)	Affiliative (*n* = 3)	Passive (*n* = 10)	Avoider (*n* = 9)	
Social behaviour					
Dominance					
Index of success	0.7a	0.4b	0.3c	0.2d	0.000
Factors					
Avoidance	−0.7a	−0.2b	0.0c	1.2d	0.001
No-agonistic	−0.1a	2.3b	−0.5a	−0.3a	0.037
Agonistic	0.7a	−0.6b	−0.9b	0.1c	0.004
Conflict resolution					
Mediator[a]	16.6a	1.3b	1.4b	1.2b	0.048
Supporter[b]	15.5a	13.3a	1.6b	1.2b	0.072
Individual behaviour					
Drinking (%)	1.25	1.25	1.28	1.59	NS
Feeding (%)	29.01a	29.01a	21.21b	33.92c	0.030
Walking (%)	20.24	19.65	22.93	20.10	NS
Resting (%)	44.02a	45.03a	49.34b	38.33c	0.008
Corporal care (%)	5.39	4.96	5.22	6.04	NS
Morphological measurements					
Distance between eyes (cm)	13.6	13.5	13.1	13.6	NS
Length of beards (cm)	14.1a	11.5b	9.9c	6.5d	0.006
Body length (cm)	89.4	91.7	88.7	88.8	NS
Height at withers (cm)	75.8	75.7	73.6	74.9	NS
Thorax circumference (cm)	92.6a	93.0b	86.4c	88.4d	0.023

Note: The *P* values correspond to the Kruskal Wallis test. a, b, c and d indicate the differences between the groups based on the results of the paired Mann Whitney test for a level of significance of $P \leq 0.05$. NS: not significant.

[a] No. of times each goat interrupted a conflict.
[b] No. of times each goat support a contender.

almost no participation in conflict resolving. This profile also obtained the highest feeding levels and the lowest resting levels in comparison to the other three identity profiles. These animals had the shortest beards and smallest thorax diameter of all the animals in the study.

4. Discussion

Our study was performed in controlled intensive commercial conditions that including the undisturbed single group of thirty goats of the same breed, same sex, similar age, multiparous, dehorned and housed in large space allowance. Under these conditions our results show the existence of an association between social strategies with identity profiles in dairy goats. The factor analysis explained 92% of variance, characterizing three factors that were termed avoidance, non-agonistic and agonistic. The determination of these three different social classes of behaviour is in agreement with previous works on dairy cows (Mülleder et al., 2003), sheep's (Cook et al., 1996) and pigs (Mendl et al., 1992; Samarakone and Gonyou, 2009).

The multivariate analysis suggests the existence of four identity profiles or groups of individuals, closely related to order of dominance, which indicates that the use of a social strategy, in particular by an individual, affects its social status (Mendl et al., 1992; Mülleder et al., 2003). Calculation of dominance values and identification of social strategies is partly based on the same behaviours and they are thus not independent (Mülleder et al., 2003). Our results show a clearly hierarchical system in terms of a dominant–subordinate relationship, where highly dominant animals, in spite of being fewer in number, can obtain priority resources in intensive production conditions. These results largely coincide with those of Barroso et al. (2000) and, to a lesser extent, with those reported by Jørgensen et al. (2007), who indicate that a hierarchical system in goats is less clear. This may be due to the fact that traditionally, hierarchy studies have described dominant–subordinate relationships but not the strategies or styles that individual animals develop. An example of this are the passive and avoider profiles that are low dominance profiles, but with substantial differences in their social behaviour.

4.1. Aggressive profile

This profile is characterized by the use of aggression as the main mechanism of social relationships. It has been suggested that the function of dominance is to reduce aggression in the group due to the fact that aggression takes up a large amount of energy and increases possibilities of injuries (Roden et al., 2005). Once it has been established, dominance is reinforced with aggression so that even in stable groups, the maintenance of social status in goats would seem to be directly related to the use of aggression (Orgeur et al., 1990; Barroso et al., 2000). We also observed resolution during conflict as a means of resolving it (Aureli and De Waal, 2000), which is when an individual comes between the two contenders and manages to stop the aggression. This mechanism has been briefly reported in goats by Tønnesen et al. (2008) and Miranda-de la Lama and Mattiello (2010). The individuals in this profile are dominant and thus only these have the potential to often stop aggressive interactions. This behavioural response indicates that animals with a high dominance monopolise and control social relationships and hence the cohesion of the group.

Our observations indicate that the percentage of times that goats with the aggressive profile were observed to eat is equal to that of the affiliative profile goats, greater than the passive profile and fewer than the avoider profile. A possible explanation for this is that the corn silage had grains, stalks and leaves which encourages selectivity and that this profile and the affiliative profile had preferential access to the most appetizing portions, leaving the remains for the rest of the animals, which would need more time to be able to consume the minimum amount of nutrients to subsist. A high relationship between the consumption of silage and aggressiveness due to competition has been reported by Jørgensen et al. (2007). It can be speculated that this profile and the affiliative profile would be the most efficient foragers as they optimise the time devoted to feeding and consume the best quality food, as reported by Matsuzawa and Hagiya (1991) and Barroso et al. (2000).

Our results indicate those only beard length and thorax diameters are morphological indicators of dominance rank. Corporal features may be honest signals that communicate a certain genetic value (Smith et al., 2009). Beards are features that are found more in male goats than female goats, although in Saanen females this is a common characteristic of the breed (MacKenzie, 1980). Our results reveal that the size of the beard is a determinant of dominance although contrary to what could be thought, longer beards are not necessarily associated with the most dominant individuals. This is also the case of thoracic circumference and this may indicate that there is a pattern of morphological development which is directly related to physical traits of dominance and that when it is not reached or it is exceeded, the external signal of dominance weakens and could be a decisive factor in determining the position occupied within the social hierarchy.

4.2. Affiliative profile

This profile associated animals of average dominance that presented a high score in non-agonistic strategy. In the group context, socio-positive relationships foster the establishing of affinities and associations between individuals (Miranda-de la Lama and Mattiello, 2010). However, in terms of personality, these affiliative individuals concentrate their efforts on gaining access to resources without the need to constantly fight for them, and also with the aim of reducing social tension (Boissy et al., 2007). The balance between high reception and emission of affiliation in individuals of average dominance in comparison to animals with high and low levels, has also been observed in non-competitive conditions in cows by Val-Laillet et al. (2009). Individuals in this profile participate to a high degree in the support of contenders. Affiliation is a tool for the support of one of the contenders and can be a mechanism of affinity or friendship between certain individuals. Although it is true that this phenomenon has to be studied in greater

depth, this initial approach could explain the role played by a profile of individuality in the resolution of conflicts.

Individual behaviour variables observed for this profile and the aggressive profile are similar. A possible explanation of this may be that goats of average dominance are under less pressure than animals with a lower status and, at the same time, do not waste energy on continuous aggressive behaviour to maintain their position, which enables them to rest, feed at a similar level as the high dominance goats. Fernandez et al. (2007) have proposed that middle-ranking goats could suffer from less social pressure than the animals of inferior status and, at the same time not have to expend energy in continual aggression to maintain their position as with the most dominant animals. However, it is important to underline that this profile was formed by the lowest number of individuals in the study, which would lead us to presume that the behavioural and phenotypic skills necessary to belong to this profile are less common compared to the other profiles.

4.3. Passive profile

This profile represents low dominance animals with a clear tendency towards social passive strategy. The values obtained for the three strategies were negative. Goats' passiveness towards their environment has been described in individuals housed in poor physical conditions and this is an indicator of a low level of welfare (Wood-Gush and Beilharz, 1983). These traits could also be linked to individual profile, temperament or coping styles, although they are still a paradigm that has not been studied to any great degree in the field of animal welfare (Mills and Caplen, 2010). Whilst all of the animals in the study were exposed to the same production environment that was poor in terms of environmental stimuli, the goats in this profile seem indifferent to their social environment. Marginally, the least negative value was that of affiliation, a fact confirmed by this profile's scarce participation in support of contenders and as mediators in conflicts, perhaps as a mechanism of social integration but one that did not operate on a continuous basis.

It is widely acknowledged that social stratification is a mechanism to reduce an increase in aggressive encounters as it provides a degree of predictability and stability in social relationships (Bercovitch, 1991), however, in intensive production systems it may aggravate the monopolising of resources and affect the degree of survival of low dominance animals, in particular, those in this profile. This fact may be due to this profile having the lowest levels of time devoted to feeding and to the fact that they had the highest rest levels. These two results could point to a destructurization of individual behaviour, as a result of the reduction in energy, similar to that of a sick animal (María et al., 2004). Although it was not one of the study's objectives, some of these animals had notorious signs of progressive emaciation. Early detection of this profile could pave the way towards developing a programme of preventive medicine. Finally, the morphological characteristics show that they fall midway between the aggressive–affiliative profile in comparison with the avoider profile. This may suggest that low dominance could have two morphological pathways.

4.4. Avoider profile

This profile is characterized by the use of avoidance strategy. These results are in keeping with previous studies in which low dominance animals have a low participation in agonistic and even non-agonistic events and avoid conflicts (Mendl et al., 1992; Mülleder et al., 2003). Avoidance is perhaps the most effective, adaptive response for a low dominance animal if we compare it with the previously described apathy profile. The individuals in this profile devoted most of their time to feeding compared to the other identity profiles. A possible explanation for this is that the animals have to spend a longer period at the feeding trough and devote less time to resting in order to satisfy their dry matter requirements due to the fact that their feeding is frequently interrupted by the aggressive behaviour of the high dominance goats (McPhee et al., 1964). Morphologically they are smaller in terms of appearance based on thoracic circumference, which could be related to a morphological-physiological adaptation that makes them as efficient as possible in environments with a scarcity of resources, which means that they have less volume and need to consume less energy. The relationship between small size and low dominance has been widely described in goats and sheep (Barroso et al., 2000; Favre et al., 2008) and is an adaptive advantage in comparison with other individuals such as the passive animals because metabolically they are more efficient. Their beards are half the length of those of the affiliative and aggressive profiles.

5. Conclusions and implications

Our study has revealed that goats use different behavioural strategies to adapt to the social environment under intensive dairy production conditions. Social strategies, dominance, conflict resolution, and the percentage of time they devote to feeding and resting, beard length, thoracic circumference and the particular association of each one of these characteristics has allowed us to identify four types of identity profiles which we have termed aggressive, affiliative, passive and avoiders. We propose the use of term identity profile for describe individuality, personality and their relationship with certain morphological traits of the individuals. The relationship between physical characteristics and behavioural traits may be a valuable tool with a view to establishing a programme of preventive medicine, particularly directed towards passive individuals. Future studies should evaluate the consistency of the social strategies and of the identity profiles under non-social stress conditions, such as reluctance towards handling, environmental enrichment as well as susceptibility to disease. Being aware of individual behavioural differences could be a useful component in giving goats the opportunity to adapt to their production environment and enhance their well being, as well as developing a new, broader concept of quality, that incorporates animal welfare transversely throughout the whole of the production system as a furt-

her element of the commercial quality of the milk product and its sub-products.

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