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Abstract

Mexico is the 7th largest producer of beef in the world. The livestock transport is a vital component of today's world agrifood economy that directly impacts on the development of animal production, animal welfare, public policies, labor regulations, food safety, markets and consumers. In this study two aims were established; the first aim was to identify the attitudes and perceptions of commercial hauliers towards animal welfare and their influence on the accident risks. The second aim was to characterize the current practices of the commercial cattle transport in Mexico and to detect the risk factors for animal welfare and hauliers' wellbeing. The interviews were conducted individually at the hauliers' rest points, sanitary inspection points localized along the Federal Highway 57 or at the companies' offices of cattle transportation. We used univariate, bivariate and multivariate statistics based on a hierarchical cluster analysis. The results showed that cattle transport in Mexico is characterized for long travel distances because the cattle departed from farms in the southern states of Mexico to the feedlots located in central and northern regions of the country. The journeys of short and middle distances departed from the feedlots to the slaughterhouses. The hauliers' characteristics were: age from 29 to 48 years-old, elementary or secondary studies completed, 65% of hauliers mentioned six years of experience in cattle transport, they learned about cattle transportation by means of a family member who was already engaged in this activity. The cluster analysis identified four hauliers' groups: groups 1 and 3 were related to animal welfare and groups 2 and 4 less related to animal welfare. This study showed that empathy towards cattle was a key element in identifying hauliers at risk of road accidents during cattle transportation. Years of experience in cattle transport played an important role in emphasizing closer perceptions towards welfare. Considering current trends towards increased transport times and logistics stops, there is a need to develop systems of welfare assessment and decision-making that provide tools and protocols that can minimize the biological cost to animals and hauliers, which may have been underestimated in the past.

Keywords   One-health; Hauliers; Cattle transport; Animal Welfare; Attitudes.

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Livestock hauliers' attitudes, knowledge and current practices towards animal welfare, occupational wellbeing and operational risk factors: A Mexican survey [1]

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The authors dedicate this article in the loving memory of DVM Jesús Wilfredo Miranda Zambrano, who passed away on November 05th 2017.

1   **Abstract**

2   Mexico is the 7th largest producer of beef in the world. The livestock transport is a vital component

3   of today's world agrifood economy that directly impacts on the development of animal production,

4   animal welfare, public policies, labor regulations, food safety, markets and consumers. In this

5   study two aims were established; the first aim was to identify the attitudes and perceptions of

6   commercial hauliers towards animal welfare and their influence on the accident risks. The second

7   aim was to characterize the current practices of the commercial cattle transport in Mexico and to

8   detect the risk factors for animal welfare and hauliers' wellbeing. The interviews were conducted

9   individually at the hauliers' rest points, sanitary inspection points localized along the Federal

10   Highway 57 or at the companies' offices of cattle transportation. We used univariate, bivariate and

11   multivariate statistics based on a hierarchical cluster analysis. The results showed that cattle

12   transport in Mexico is characterized for long travel distances because the cattle departed from

13   farms in the southern states of Mexico to the feedlots located in central and northern regions of the

14   country.   The journeys of short and middle distances departed from the feedlots to the

15   slaughterhouses. The hauliers' characteristics were: age from 29 to 48 years-old, elementary or

16   secondary studies completed, 65% of hauliers mentioned six years of experience in cattle transport,

17   they learned about cattle transportation by means of a family member who was already engaged

18   in this activity. The cluster analysis identified four hauliers' groups: groups 1 and 3 were related

19   to animal welfare and groups 2 and 4 less related to animal welfare. This study showed that

20   empathy towards cattle was a key element in identifying hauliers at risk of road accidents during

21   cattle transportation. Years of experience in cattle transport played an important role in

22   emphasizing closer perceptions towards welfare. Considering current trends towards increased

23   transport times and logistics stops, there is a need to develop systems of welfare assessment and

24   decision-making that provide tools and protocols that can minimize the biological cost to animals

25   and hauliers, which may have been underestimated in the past.

26

27   **Keywords:** One-health; Hauliers; Cattle transport; Animal Welfare; Attitudes.

1. Introduction

Moving livestock safely between farms, auction markets, feedlots and abattoirs are essential links of modern animal production (Gilkeson et al., 2016). Additionally, the protection and improvement of appropriate animal welfare during transport are priorities for the beef industry and for societies worldwide (Thomson et al., 2015). However, even under favourable conditions the stress of transportation can produce several negative consequences such as body weight and feed consumption losses, impairment of the immune system, morbidity and mortality caused by changes in the thermal micro-environment, weather conditions, animal mixing, handling, feed and water restrictions, vibrations, vehicle acceleration, associated fatigue, loading/unloading, injuries, extreme noises, environmental pollutants and human-animal interactions (Cernicchiaro et al., 2012; Miranda-de la Lama et al., 2014). Consequently, animal welfare during transport depends greatly on the attitudes and training of handlers and the appropriate cattle facilities (Pulido et al., 2018). In this way, precise characterization of transport logistics and operational practices are required for developing animal welfare risk assessment guidelines for cattle transport (Marahrens et al., 2011).

Occupational performance is affected by several factors, including job satisfaction, motivation, self-efficacy, achievement, physical and psychological fatigue, environment, and organization identification (Zhao et al., 2015). The professional hauliers are required to deliver live and healthy animals on time; they are under pressure to drive for long periods and irregular driving schedules. Therefore, hauliers are exposed to extended shifts, sleep restrictions, postural fatigue, exposure to noise-vibration, sedentary lifestyle, unhealthy diet, exposure to diesel exhaust fumes, handling for loading/unloading animals and other occupational stressors, which increase the risk of road accidents (Miranda-de la Lama et al., 2011). Hence, hauliers are of vital interest not only in the animal welfare perspective but also in the one-health perspective. The one-health concept has been extensively used to describe transdisciplinary actions that protect the welfare of animals, humans, and the environment, an approach that should be adopted by the veterinary science worldwide. Ironically, despite its potential scope, research about One-Health has focused frequently on surveillance and prevalence of zoonotic and vector-borne diseases. In the meat production, One-Health could help to promote key global objectives such as standards that guarantee the health and welfare of farm animals, preventing or reducing occupational hazards that may affect farmers,

59   hauliers and abattoir operators, promotes sustainability in animal production and generate an

60   integrative vision of the human-animal interactions.

61

62   A holistic approach must be adapted to meet present and future challenges by getting physicians,

63   veterinarians, biologists, sociologists and many others to cooperate for the one-health approach

64   closely linking human and veterinary medicine (Conraths et al., 2011). Much has been learned

65   about stress during transport, but less attention has been paid to identify and correct risks factors

66   from the point of view of interactions between hauliers and animals, partly because they vary

67   widely both nationally and internationally (Herskin et al., 2017). Whereby, there is an increasing

68   interest in understanding how the hauliers' attitudes towards animal welfare can affect the

69   performance during the transport operations. It is therefore interesting to examine the operating

70   procedures of Mexican hauliers to identify any detrimental effect that operations might have on

71   animal welfare, to be able to recommend appropriate changes in handling protocols and to develop

72   training programs that could minimize the biological cost of animals during transportation and

73   thus minimize weight looses, morbidity, mortality and/or defects in meat quality. To promote and

74   regulate policy targets for animal welfare during transport, it is important to gain knowledge on

75   the current practices of hauliers in Mexico. Therefore, two aims were established; the first aim was

76   to identify the attitudes and perceptions of commercial hauliers towards animal welfare and their

77   influence on the risk of accidents. The second aim was to characterize the current practices of the

78   commercial cattle transport in Mexico and to detect the risk factors for animal welfare and hauliers'

79   wellbeing.

80

81   **2. Material and Methods**

82   The study was carried out in the State of Queretaro (north-central Mexico) from February to July

83   2017 because it represents one of the largest feedlots regions in Mexico. The interviews were

84   conducted individually at the hauliers' rest points (restaurants and gas stations), at the sanitary

85   inspection points of cattle localized along the Federal Highway 57 or at the companies' offices of

86   cattle transportation. The Federal highway 57 crosses Queretaro State and links many major

87   highways that connect four main roads across the Mexican Republic and it is an obligatory State

88   to move cattle from the south to north and from east to west of the country. The study protocols

89   were approved by the Institutional Animal Ethics Committee for the Care and Animal Use
90   (CICUAE) of the National Autonomous University of Mexico (UNAM).

91

92   *2.1. Study description*

93   Snow-ball sampling was followed for the enrolment of participants because it has been
94   documented as a helpful technique to target samples that may be hard-to-reach (Faugier and
95   Sargeant, 1997), briefly the procedure sampling was as follows; the hauliers that accepted initially
96   being surveyed linked us with other colleagues that were willing to collaborate in the study by
97   means of "WhatsApp" and "social networks". The sample size was determined based on the
98   project time and the willingness of hauliers to provide information. The surveyed hauliers drove
99   "pot-belly" trailers only because this type of trucks mobilize 70% of the commercial cattle in the
100 country. In Mexico, there are at least 1100 pot-belly trailers (AMIS, 2013). The pot-belly trailers
101 are part of the agrifood chain because of the insertion of Mexico (especially in cattle) in the North
102 American Free Trade Agreement (NAFTA) in the past 30 years with the U.S.A. and Canada, in
103 part because of larger loading capacities give as a result low transportation cost per animal.

104

105 A face-to-face survey was carried out with 74 male professional hauliers between 18 and 62 years-
106 old (mean=40, SD= 10.7) from 38 cattle transport companies. There were no women working as
107 hauliers in this activity. Demographic features of participants are presented in Table 1. The
108 interview lasted between 30 to 40 minutes. To minimize the bias, we ensure that the participants
109 had not known the main objectives of the study (Daros et al., 2017). The interested hauliers in the
110 study were informed that: "participation is voluntary, the information collected is confidential"
111 and if they finally do not participate or if the participants decide to leave the study "their future
112 employment conditions won't be affected". No financial remuneration was offered to the
113 participants. The participants had the heavy lorry driver's license.

114

115 *2.2. Questionnaire and measurement scales*

116 The questionnaire for this survey was designed to ensure that the interview process did not
117 overwhelm the hauliers and questions were written down to ensure consistent interpretation among
118 participants (Cherry and Adelakun, 2012). A pilot study was carried out in January 2017 using a
119 draft questionnaire and it was applied to 7 hauliers (these participants were excluded from

120 subsequent questionnaires), then the results were used for the development of the final
121 questionnaire that contained 51 questions divided into four sections. The first section (S1)
122 "Demographic profile" focused on determining the profile of hauliers' population; the second
123 section (S2) was related to "accidents and occupational risk"; the third section (S3) covered
124 "livestock transport logistics" and finally the fourth section (S4) "animal welfare attitudes", related
125 with hauliers' attitudes and perceptions towards livestock welfare. The sections S2 and S3
126 consisted of questions about operational and logistic practices during transport; the operational
127 part considered time to unload animals, vehicle load capacity, number of kilometres of the journey,
128 transportation time during a journey, occupational hazards, number of inspections carried out
129 during the transport of cattle in a journey, loading time of cattle, transportation cost per head, body
130 weight loss of cattle during the journey, percentages of dead and injured cattle. The logistic chain
131 of cattle transport considered the following questions; origin of the journey, methods used by
132 hauliers for minimising sleepiness, cattle classification during pre-loading, cattle handling during
133 loading and unloading, aggressive handling. The fourth section considered perceptions and
134 attitudes towards animal welfare; the responses were based on a 5-point Likert scale (Miranda-de
135 la Lama et al., 2017). Questions in this section included perceptions of hauliers towards animal
136 welfare and whether new animal welfare laws are required to prevent animal abuses during
137 transport operations. The information was obtained by the initial statement *'Do you think that ...'*
138 and measured with an ordinal scale of five points (1=surely not, 2 =probably not, 3 =it does not
139 matter to me, 4 =probably yes, and 5 = definitely yes). In the same section, the participants were
140 asked about their perception of three aspects of animal welfare based on a literature review (pain,
141 suffering, feelings and fear).

142

143 *2.3. Specifications of statistical analyses*
144 Descriptive statistic, univariate, bivariate and multivariate statistic were used for data analysis. A
145 hierarchical cluster analysis (using Ward's method and the Squared Euclidian distance) was used
146 to identify hauliers' profiles (types or groups), variables associated to attitudes and emotions
147 towards animal welfare were used for this analysis. The groups were defined based on the
148 observation of the dendrogram. A cluster name was assigned to each group of hauliers and a
149 dummy variable called "cluster membership" was created to identify the haulier's group. Chi-
150 squared and Kruskal–Wallis tests were used to test significant differences ($P<0.05$) between

151 groups of hauliers on a set of socioeconomic and production variables (both qualitative and
152 quantitative) that were not used in the cluster analysis. Thus, the final clusters were profiled by
153 cross-tabulating the variable "cluster membership" with the variables mentioned earlier. All
154 statistical analyses were performed with the IBM®-SPSS® 22 version.

155

156 **3. Results and discussion**

157 Although it is generally accepted that hauliers have an influence on the suffering of animals during
158 transport, there is no significant research that investigates the relationships between animal
159 welfare, occupational wellbeing and operational risk factors. Therefore, our study is a pioneer in
160 clarifying these relationships using a national case to understand a phenomenon with broad
161 international implications. It is conceivable that cattle welfare during transport may be interpreted
162 differently from country to country due to culture and tradition. With this in mind, future research
163 should focus on international cooperation and training of all parts of the cattle logistic chain in
164 order to secure more uniform interpretation of cattle welfare during transport (Dahl-Pedersen et
165 al., 2018) across international borders as Mexico, United States of America and Canada.

166

167 *3.1. Hauliers perceptions towards cattle welfare and their influence on the risk of accidents*

168 Recently some studies used the multivariate perspective to understand the role of attitudes and
169 personality on the behaviour of hauliers and animal welfare (Pulido et al., 2018). Whereby, there
170 is an increasing interest in understanding haulier's attitude with respect to management of the
171 transported cattle (Herskin et al., 2017). The cluster analysis suggested the existence of four
172 clusters or hauliers' profiles (G1, G2, G3, G4; Table 3). The four factors corresponding to attitudes
173 towards animal welfare showed differences ($P<0.05$) among groups. The four profiles were
174 determined by three questions about the recognition of emotions in animals and the need to express
175 their natural behaviour in addition to three other questions about information, legal regulations and
176 the impact of stress on the meat quality. The level of education and age did not influence the
177 hauliers' profiles. However, there was an association between hauliers' perceptions with years of
178 driving experience and the risk of accidents on the road. The G1 and G3 groups showed a high
179 empathy and recognition of the emotions experienced by the cattle, on the other hand, low values
180 of acceptance were observed in G2 and G4. In all profiles it was recognized that animals
181 experience pain sometimes during transport. Although years of experience in the profession,

182 education and age did not affect this perception, it is likely that everyday experiences during

183 transportation will confront drivers with situations of animal suffering. Although there are no

184 studies in the scientific literature about the perception and opinions of hauliers about animal pain,

185 studies on farmers of dairy cattle in Norway (Kielland et al., 2010) and pigs in the United Kingdom

186 (Ison and Rutherford, 2014) coincide generally with our results.

187

188 The recognition of animals as perceptive beings that can suffer unless handled properly resulted

189 in farm animal welfare regulations of both a public and private nature worldwide (Hansson and

190 Lagerkvist, 2016). There is now a substantive body of evidence to support the central and crucial

191 role of such emotional experiences and processes (both positive and negative) in human decision-

192 making (O'Kane et al., 2017). Kielland et al. (2010), reported that farmers who perceive that

193 animals feel pain as humans do have greater empathy towards cattle and better welfare outcomes

194 on their farms. Our study showed that in Latin America (Vargas-Bello-Pérez et al., 2017), and

195 specifically in Mexico, there are evidence of some favorable perceptions of animal welfare not

196 only in citizens and consumers (Miranda-de la Lama et al., 2017) but also in sectors that work

197 directly in animal production systems such as hauliers. The degree of empathy towards animal

198 welfare is a key element to develop intervention strategies for the prevention of risks for animal

199 welfare and occupational welfare of hauliers. Interventions should also include multiple

200 components that target several risk factors (and not only one factor) to better understand which

201 risk factors should be modified for a better welfare outcome in addition to the cost savings. For

202 example, a change in behavior related to one risk factor can improve the outcomes of another

203 (Crizzle et al., 2017). Training in animal welfare and ethological handling, for instance, can lead

204 to empathy towards animals and better handling practices, thus reducing risks of road accidents.

205 The addition of cost-effectiveness and benefit analysis will determine whether the interventions

206 on animal welfare could lead to cost savings for the employer and to improve carcass and meat

207 quality (Schwartzkopf-Genswein et al., 2008).

208

209 *3.1.1. Hauliers groups 1 and 3: Empathy towards animal welfare*

210 Animal welfare involves societal and human values, ethical concerns and moral considerations

211 since it incorporates the belief of what is right or what is wrong in animal management and care

212 (Cembalo et al., 2016). In this context, G1 and G3 were characterized by showing a high empathy

213   towards animals and recognized that cattle should have the opportunity to display their natural
214   behaviors, like feeling pain and experiencing positive and negative emotions. They were highly
215   aware of the effect of stress on the quality of meat during transport and pre-slaughter operations.
216   Although both groups were empathic towards cattle, the differences between the two groups were
217   notable about the information and the need for new animal welfare laws that regulate
218   transportation. There was a concern in G3 about the lack of information and the need for new laws,
219   this profile was self-critical and reflective more than G1, which was closer to conformism and a
220   neutral attitude to legal change. In Mexico, the information about this issue is scarce, although the
221   social pressure is forcing some companies to incorporate these policies. It is likely that G1 is
222   worried about animal welfare but not to the extent of making important changes that could affect
223   them, although they may feel socially under pressure and may have a "politically correct" position.
224   Recently, Mexican consumers are concerned and there is a tendency to demand products that
225   guarantee humane treatment of farm animals (Miranda-de la Lama et al., 2018a), part of this
226   concern has been encouraged by national and especially international animal protection groups
227   that operate in the country (Vargas-Bello-Pérez et al., 2017). Previous research has found that
228   animal protection groups are more credible sources of information than livestock industry groups
229   and this positive perception tends to increase following animal abuse scandals (Robbins et al.,
230   2016).
231

232   The G3 group is undoubtedly an interesting profile, they were empathic towards cattle, but at the
233   same time, they were the most realistic of the animal welfare situation in Mexico, even compared
234   to G1. It is probable that the experience of more than six years in the profession was a determining
235   factor for this result. One explanation could be that experience will cause a change in perception
236   which will enable a new level of thinking that is based on each situation along with more holistic
237   knowledge compared to the beginner's abstract knowledge (Pfrunder et al., 2017). Finally, G1 and
238   G3 showed the lowest accidents on the road; however, G3 perceived road accidents as the most
239   serious risk in their activity.
240

241   *3.1.2. Hauliers groups 2 and 4: skepticism towards animal welfare*
242   Attitudes are reflected in human's behaviour towards cattle, which in turn, affects animal behavior,
243   welfare and productivity (Kauppinen et al., 2012). We observed that G2 was a transition between

244   G1 and G3, recognizing pain and emotional states in cattle, but they were neutral in relation to the

245   need of animals to express natural behaviors of the species. In the case of G4, they neither

246   recognized that animals could feel emotions nor the need to express natural behaviors. The lack of

247   empathy of the hauliers is a risky situation because it can trigger bad management practices,

248   indolence and even abuse towards animals (Grandin, 1988). The main priority for animal welfare

249   at a livestock transport company is to avoid either animal abuse or obvious pain and suffering

250   (Grandin, 2014). Additionally, animal welfare during transport operations is a point of concern to

251   consumers and animal abuse results in public outrage (Small and Hewitt, 2017).

252

253   Both groups coincided with the insufficient information about animal welfare in Mexico and the

254   absence of new laws regulating cattle transport. However, hauliers in G4 were aware that stress

255   during transport could affect the quality of the carcass and meat (mainly hauliers with more than

256   6 years of experience), while hauliers in G2 denied this could be true (mainly hauliers with less

257   than 6 years of experience). Hauliers in both groups suffered more accidents on the road than G1

258   and G3, especially rollover in G4 (the most frequent cause of accidents). The rollovers were

259   accidents related to the variables of empathy towards the animals and the driving experience.

260   Scientific literature indicates that fatigue has a detrimental effect on driving even when the driver

261   does not fall asleep, cognitive and psychomotor function decreases as manifested by distraction,

262   poor concentration, slow reactions and performance errors (Hadas et al., 2017). Several studies

263   have shown that personality traits are associated with risky driving behaviors and traffic accidents

264   (Tao et al., 2017). To overcome these constraints, hauliers must be actively involved to raise

265   awareness. A contribution of the present work to the literature is that our findings clarified and

266   emphasized the role of driving experience and perceptions towards animal welfare in risky driving

267   behaviors and accidents.

268

269   *3.2. Cattle transport characterization in Mexico: Operations and risk factors*

270   Beef production in Mexico is characterized by calves that typically start their lives on breeding

271   farms in the tropical regions of Mexico and Central American countries; in these areas the calves

272   remain with the mother for seven months or even more in some cases and after being weaned they

273   are transported to feedlots located in the semiarid regions of Mexico. In Mexico, there is free

274   movement of animals from one state to another and this has stimulated an increase in long journeys

275   between farms or from farms to slaughterhouses (Miranda-de la Lama et al., 2012; 2018b).

276

277   *3.2.1. Operational issues and logistic practices*

278   According to the information collected in the surveys, hauliers make different routes according to

279   the supply and demand for livestock throughout the year. A total of 40 cattle mobilization routes

280   were identified (Fig. 2). Seven of these routes corresponded to short-distance journeys (less than

281   eight hours) according to the European Parliament's declaration that supports a limit of eight hours

282   for cattle transport (Miranda-de la Lama et al., 2014) and 33 remaining routes corresponded to

283   long-distance journeys from southern region of Mexico because lower production costs and a high

284   cattle inventory (SIAP, 2017) were found in the southeast of Mexico (70.8%). The region of central

285   Mexico was mentioned as a center of re-distribution of cattle brought from the south that

286   represented 16.9% of total journeys, while the northern region showed 12.4% of the journeys. The

287   State of Chiapas concentrated 29.4% of total journeys from the southern region, followed by

288   Tabasco state (23.8%) and Veracruz state (11.3%), other Mexican states were mentioned as less

289   frequent. Differences in salary were observed depending on the haulier's experience,

290   independently of the journey time (71.63 ± 27.18 hours) to collect cattle in southern Mexico. The

291   average salary was $191 US dollars for hauliers with 4 to 6 years of experience and $313 US

292   dollars for hauliers with more than 10 years of experience for the same journey.

293

294   Transportation and loading operations for several hours is a physically demanding factor; animals

295   must maintain balance and the contact between animals produces fatigue and bruises that affect

296   animal homeostasis (Losada-Espinosa et al., 2018). The journeys' time was measured in two ways;

297   the first approach considered total hours that took a haulier to do a round-journey, the time included

298   spent hours at the animal health inspection and verification points, toilet, meals and mechanical

299   failures. The second approach considered spent hours once the cattle were shipped and delivered

300   to the fattening centres at the destination point. Both approaches showed that hauliers spent more

301   than eight hours driving when cattle were shipped in the southern region of Mexico, journey time

302   for the northern and central regions were less than eight hours. About the collection points, 51.4%

303   of the hauliers collected cattle at specific farms while 48.6% shipped cattle in a collection centre.

304   Hauliers mentioned a delay in the shipment of cattle that extended journey time (53.5%), the main

305   cause of delay was the lack of cattle to complete the maximum capacity of the trailer to minimise

306   transportation cost per head, however hauliers mentioned to solve this problem on the same day

307   or up to three days later.

308

309   The participants mentioned that they did cattle selection and accommodation prior to the shipment

310   (90.5%), which according to them facilitated cattle management during the journey. Cattle

311   accommodation was based on the size of the animal (86.6%), always locating the smaller cattle on

312   the second floor and the biggest on the first floor for balancing the load. The hauliers who did this

313   type of selection also mentioned the risk involved for cattle and for themselves when the mixture

314   of cattle from different places and sizes was performed. The time required for cattle

315   accommodation during loading was longer than unloading (Fig. 3). Significant differences were

316   observed in the loading and unloading times according to hauliers' age. Younger hauliers showed

317   shorter loading (P=0.019) and unloading (P=0.005) times; the time increased according to haulier's

318   age increased. The latter could be explained by older people, who took greater care during this

319   activity due to their experience with cattle management or it may be related to a deterioration in

320   their ability to conduct this activity.

321

322   To move cattle during loading and unloading and during the journey, hauliers used electric prods

323   as a first option (56.8%), shouting (20.3%) and others (10.8%). The use of the electric prods was

324   justified as a necessary tool to avoid the death of cattle that fell down during the journey. However,

325   electric prods are very stressful for cattle. According to Grandin and Shivley (2015), the use of

326   electric prods is the main problem observed by private industry and some governments when

327   auditing animal welfare at transport operations and slaughter plants. Previous studies have shown

328   that increased handler interaction is correlated with an increased physiological stress response in

329   cattle and that tactile interactions and high-pitched or loud noises are associated with suffering,

330   carcass bruising and high meat pH (Miranda-de la Lama et al., 2011; Probst et al., 2014; Romero

331   et al., 2017).

332

333   Hauliers mentioned to carry out long travel distances without assistants (58.9%) and 41.1%

334   mentioned an assistant for general activities. It was found that participation of an assistant in

335   journeys from the southern region represented an advantage within the logistic chain because a

336 significant decrease of more than four hours was found (P=0.026). Those hauliers who did cattle
337 selection and accommodation prior to the shipment (P=0.008) as well as loading and unloading
338 activities showed greater concern for cattle and they mentioned the need to create new laws about
339 animal welfare (P=0.028) than those who were not involved in the handling of cattle. Cattle
340 transported throughout the country were a mixture of commercial hybrids (F1; Bos indicus x Bos
341 taurus) that represented 81.1%, Bos indicus (14.9%) and Bos taurus (4.0%). Hauliers transported
342 males (63.5%) and both males and females (36.5%). The size of the livestock that was shipped at
343 the collection points was variable, however, 58.1% of the hauliers were dedicated to collect cattle
344 of 350 kg BW or less with an average of 80±16 heads per trailer; 40.5% collected cattle between
345 351 and 450 kg BW with an average of 68±6 heads per trailer and only 1.4% transported cattle
346 with more than 450 kg BW with an average of 48±4 heads per trailer. Despite the number of heads
347 per trailer mentioned above; 86.5% of the hauliers mentioned no mortality during the journey,
348 12.2% mentioned that one animal died due to long journeys and 1.4% mentioned to have a
349 mortality of two animals per trailer. The participants mentioned (51.4%), that cattle did not show
350 visible lesions caused during the journey while 48.6% observed up to five animals with injuries
351 caused during the transportation. A probable explanation for these results is the poor ability of
352 drivers to recognise pain and injuries in animals. Well-trained personnel and hauliers can favor a
353 good human-animal interaction and can promptly recognise early signs of lesions and diseases
354 (Bertocchi et al., 2018).
355
356 *3.1.2 Risk factors for the occupational wellbeing and animal welfare*
357 Driving is a risky occupation; it shows high rates of injuries and illnesses from all occupations in
358 the world (Versteeg et al., 2018). In our study, the transport of "live cargo" (as hauliers referred to
359 cattle transportation) involves other types of risks during mobilization and handling of livestock;
360 28.4% of the hauliers said they had suffered accidents during handling of livestock. The most
361 common were falls (71.4%), followed by knocks (23.8%) and body injuries like body twists and
362 muscle contractures (4.8%). These accidents occurred more frequently due to cattle handling
363 (61.5%), while the second cause perceived by hauliers was a poor design of transport (23.1%),
364 7.7% mentioned a poor maintenance of the trailers and the remaining 7.7% mentioned the rainfall
365 as a cause. To evaluate the perception of hauliers about the design of this type of trailer, an image
366 of a commercial trailer was inserted in the survey (Fig. 1). Hauliers mentioned that compartment

four known as "deck" was the most unsafe, because 47.6% of the accidents occurred due to the difficulty of getting in and getting out, 19.0% occurred in the stairs, 14.3% in the ramps located inside the trailer, 4.8% occurred in the back door and the remaining 14.3% in other sections. According to hauliers' experience; 43.2% considered that compartment one (also is known as "front") was the section of the trailer where livestock management was complicated because for cattle was difficult getting in without getting back at least once, another 43.2% considered that the difficulty with cattle handling was not related with the compartment and the remaining 13.6% mentioned "other" compartments. Hauliers (4.1%) considered that cattle injuries were frequent in compartment one, 2.7% in compartment two, 2.7% in compartment four and 4.1% mentioned "others"; nonetheless, 86.5% assured that the compartment was not the main cause but a deficient accommodation of cattle.

Hauliers could be under high levels of stress and fatigue due to excessive traffic, extended periods away from home (Boyce, 2016) and handling of animals (Pulido et al., 2018). According to our survey, cattle transport in Mexico increased the risk associated with this activity. These risks were extended beyond the possibility of suffering an accident during the journey or suffering illnesses associated with extended working hours. The working hours of hauliers in Mexico were variable; it depends on the type of service required by producers as well as the distance in the journey according to the region of origin and final destination of the cattle (north, middle or south of the country) (Table 2). It was found that once the animals were shipped for departing, hauliers stop only at the animal health inspection and verification points during the journey and while animal inspection was carried out hauliers had their lunch and used the toilets at these points; therefore 63.5% of the hauliers mentioned to stop seven times or more and 29.7% four or six stops. In both cases hauliers mentioned to collect cattle from the north and south of the country, the rest of the hauliers (6.8 %) mentioned stopping three times because the journey was carried out in the central region of Mexico.

Six risk factors for hauliers were identified; 37.8% mentioned that the main risk was cattle theft which has become very common in recent years and could happen in each journey, 18.9% mentioned road accidents and money-belongings thefts, 12.2% mentioned government extortions, 10.8% mentioned truck thefts and finally 1.4% mentioned hauliers' murders. According to the

398 participants and the Mexican Institute for the Competitiveness A.C. (2016), Guerrero State is

399 considered one of the most dangerous places to collect cattle, therefore, cattle transport companies

400 do not want to collect cattle from Guerrero State or might be carried out occasionally. Accidents

401 involving hauliers represented a serious threat of working safely, public health and animal welfare.

402 There are many causes for traffic accidents, such as mechanical failure on vehicles, human failure

403 and problems on the roads beside the use of psychoactive substances that decreases the hauliers'

404 capability to drive safely (Bombana et al., 2017). Our results showed that 23.0% of the participants

405 were involved in road accidents of different types and causes. The commonest accidents reported

406 in this study were rollover (58.8%), collision with another vehicle (29.4%) and 11.8% trucks

407 offroad without damages.

408

409 The main cause of the accidents was fatigue (29.4%), other driver's fault (23.5%), distraction while

410 driving (17.6%), mechanical failures (11.8%) and the rest (17.6%) mentioned other causes. In

411 Mexico, there are no records of road accidents involving livestock trucks, the most affected

412 species, and vehicle type are unknown, in the United States of America and Canada the species

413 frequently involved in an accident is cattle (Woods and Grandin, 2008), swine and cattle in Spain

414 (Miranda-de la Lama et al., 2011). It was mentioned that 58.8% of the accidents occurred between

415 20:00 and 05:05 h, all of them occurred because the hauliers were driving continuously for more

416 than 10 hours which is common in Mexico, 29.4% of the accidents occurred between 06:00 and

417 12:59 h and only 11.8% between 13:00 and 19:59 h. Fatigue during driving has been acknowledged

418 as a major contributor to road accidents among long travel distances (Woods and Grandin, 2008).

419 The incidence is greater for hauliers of articulated trucks (i.e. Pot-belly trailers) because delivery

420 schedules affect the hauliers' resting time. Bigger size and mass of these trucks concomitantly

421 increases the severity of injuries and/or the likelihood of fatality (Darwent et al., 2012). From the

422 total accidents recorded, 82.4% occurred when hauliers were transporting cattle to the

423 slaughterhouse and only 17.6% occurred without cattle. The average cattle injured were 8.3

424 animals per trailer and the body weight at the time of the accident was 350-450 kg (85.7%) and

425 550 kg (finished cattle, 14.3%). The animals that survived to the accident were transported in

426 another vehicle (57.1%), while 14.3% continued the journey in the same trailer when the vehicle

427 damage was not severe, 14.3% reported cattle theft at the accident site and the remaining 14.3%

428 did not specify what happened with cattle that survived. In Mexico, there are no specific protocols

15

429 for livestock transport accidents that specify how to get cattle out of the vehicle if survived to the

430 accident or in case of animal suffering (Pulido et al., 2018). These situations may occur in other

431 countries around the world; however, specifically Mexico is facing bureaucracy challenges and

432 crime situations that represent a risk for hauliers and transport companies, therefore protocols for

433 these situations are required.

434

435 Hauliers work in an environment that requires long periods of relative immobility in the driver seat

436 of a vehicle. This can contribute to an inactive lifestyle that may ultimately lead to poor health.

437 This is especially true when coupled with a poor diet, which many truck hauliers face due to

438 unhealthy foods (Boyce, 2016). The health status and consumption habits of Mexican hauliers

439 during the journey were evaluated. In relation to health condition; 47.3% of hauliers mentioned

440 "good health" and highlighted that they must be checked at the national health service every two

441 years, therefore hauliers should approve health tests if they want to renew the driver license, 10.8%

442 mentioned "do not know" if they present a health problem, 12.2% mentioned overweight and

443 obesity problems, 10.8% mentioned back problems, 9.5% sleep disorders, 9.5% gastritis, 4.1%

444 arterial hypertension, 4.1% diabetes, 2.7% colitis, 2.7% high levels of cholesterol and 1.4% kidney

445 disease. From the later health problems, only 14.3% of hauliers mentioned being under medical

446 prescription. There is a tendency to consume certain products among hauliers during long journeys.

447 The consumption of products that could have harmful effects for health was mentioned, including

448 soft drinks (85.1%), coffee (77%) and cigarettes (70.3%). These two latter products and energy

449 drinks (56.8%) were consumed to minimize sleepiness. On the other hand, 37.8% consumed "junk

450 food" while driving to reduce the number of stops during the journey. Only significant differences

451 (P<0.001) were found between age and smoking cigarettes; hauliers reduced smoking cigarettes

452 in the range of 39 to 48 years-old and after 49 years-old increased considerably.

453

454 To combat the detrimental effects of fatigue, some hauliers used licit and illicit stimulants (Davey

455 et al., 2007). Little research exists on the prevalence of stimulant use among livestock hauliers.

456 From our results, 77% of the hauliers affirmed to consume drugs that help them to stay awake and

457 alert during long journeys. The active substance of these drugs was "clobenzorex hydrochloride"

458 which is an anorexigenic medication for prolonged release to lose weight that according to

459 Espinosa and Morín (2013) causes adverse effects such as insomnia. For this reason, its

460   consumption was common not only in cattle hauliers but also hauliers of other types of cargo.

461   According to the participants they consumed 30 to 900 mg in periods of 24 and 72 hours. The side

462   effects of these drugs have been studied in doses lower than those found in this study, so the effects

463   of these doses on health are still unknown. Research suggests stimulants might improve both

464   cognitive performance and driving performance when used to combat fatigue. Even though

465   stimulants can enhance cognitive functions such as vigilance, attention, psychomotor functioning,

466   memory, and visuospatial/visuomotor capabilities, however, research suggests they could develop

467   driving impairments (Gate et al., 2013). The different risks of this activity and its possible causes

468   should be studied carefully to work on prevention because not only live's integrity and health of

469   hauliers are compromised, but also other people's lives and cattle welfare.

470

471   **Conclusions**

472   Our results showed the need to generate an integrative vision in the livestock industry that is a

473   symbiosis between sustainability, human and animal welfare, that means "One-Health". Cattle

474   welfare during transport should be a priority for the livestock industry, without leaving aside

475   wellbeing, health and labor rights of hauliers. It is likely that a company does not meet acceptable

476   standards of operational quality in animal welfare without establishing a social responsibility

477   policy that creates a healthy working environment for hauliers and related personnel. A motivated,

478   trained and concerned worker towards cattle will be committed to the quality of their work and

479   avoid practices that put cattle welfare and transport operations at risk. In Mexico, there are no

480   specific laws for cattle welfare during transport. This study has been the first attempt for the

481   development of the first Mexican national protocol (perhaps extrapolated to Latin American

482   countries) for the prevention of operational risk factors, haulier's occupational wellbeing and cattle

483   welfare during transport.

484

485   **Conflict of interest**

486   None of the authors of this paper has a financial or personal relationship with other people or

487   organizations that could inappropriately influence or bias the content of the paper.

488

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496 **References**

497 AMIS, 2013. Sistema estadistico de datos sectoriales. Asociacion Mexicana de Instituciones de

498   Seguros. https://www.amis.com.mx/InformaWeb/.../resumen_SESA_autos_2013_v3.xlsx

499 Bertocchi, L., Fusi, F., Angelucci, A., Bolzoni, L., Pongolini, S., Strano, R. M., ... Lorenzi, V.

500   2018. Characterization of hazards, welfare promoters and animal-based measures for the

501   welfare assessment of dairy cows: Elicitation of expert opinion. Prev. Vet. Med. 150, 8-18.

502 Bombana, H.S., Gjerde, H., Dos Santos, M.F., Jamt, R.E.G., Yonamine, M., Rohlfs, W.J. C., ...

503   Leyton, V. 2017. Prevalence of drugs in oral fluid from truck drivers in Brazilian highways.

504   Forensic. Sci. Int. 273, 140-143.

505 Boyce, W.S. 2016. Does truck driver health and wellness deserve more attention?. J.

506   Transp. Health. 3(1), 124-128.

507 Cembalo, L., Caracciolo, F., Lombardi, A., Del Giudice, T., Grunert, K. G., Cicia, G. 2016.

508   Determinants of individual attitudes toward animal welfare-friendly food products. J. Agric.

509   Environ. Ethics. 29(2), 237-254.

510 Cernicchiaro, N., White, B. J., Renter, D. G., Babcock, A. H., Kelly, L., Slattery, R. 2012. Effects

511   of body weight loss during transit from sale barns to commercial feedlots on health and

512   performance in feeder cattle cohorts arriving to feedlots from 2000 to 2008. J. Anim. Sci.

513   90(6), 1940-1947.

514 Cherry, C.R., Adelakun, A.A. 2012. Truck driver perceptions and preferences: Congestion and

515   conflict, managed lanes, and tolls. Trans. Policy. 24, 1-9.

516 Conraths, F.J., Schwabenbauer, K., Vallat, B., Meslin, F.X., Füssel, A.E., Slingenbergh, J.,

517   Mettenleiter, T.C. 2011. Animal health in the 21st century—a global challenge. Prev. Vet.

518   Med. 102, 93-97.

519 Crizzle, A. M., Bigelow, P., Adams, D., Gooderham, S., Myers, A. M., Thiffault, P. 2017. Health

520   and wellness of long-haul truck and bus drivers: A systematic literature review and directions

521   for future research. J.Transp. Health.

522 Dahl-Pedersen, K., Foldager, L., Herskin, M. S., Houe, H., Thomsen, P.T. 2018. Lameness scoring
523 and assessment of fitness for transport in dairy cows: Agreement among and between
524 farmers, veterinarians and livestock drivers. Res. Vet. Sci. 119, 162–166.

525 Daros, R.R., Hötzel, M.J., Bran, J.A., LeBlanc, S.J., von Keyserlingk, M.A. 2017. Prevalence and
526 risk factors for transition period diseases in grazing dairy cows in Brazil. Prev. Vet. Med.
527 145, 16-22.

528 Darwent, D., Roach, G., Dawson, D. 2012. How well do truck drivers sleep in cabin sleeper
529 berths?. Appl. Ergon. 43(2), 442-446.

530 Davey, J., Richards, N., Freeman, J. 2007. Fatigue and beyond: patterns of and motivations for
531 illicit drug use among long-haul truck drivers. Traffic. Inj. Prev. 8(3), 253-259.

532 Espinosa-Franco, B., Morín-Zaragoza, R. 2013. Efectos adversos de farmacos anorexigenicos de
533 liberacion prolongada. Vertientes. Revista Especializada en Ciencias de la Salud. 16, 1.

534 Faugier, J., Sargeant, M., 1997. Sampling hard-to-reach populations. J. Adv. Nurs. 26, 790–797.

535 Gates, J., Dubois, S., Mullen, N., Weaver, B., Bédard, M. 2013. The influence of stimulants on
536 truck driver crash responsibility in fatal crashes. Forensic. Sci. Int. 228(1), 15-20.

537 Gilkeson, C.A., Thompson, H.M., Wilson, M.C.T., Gaskell, P. H. Quantifying passive ventilation
538 within small livestock trailers using Computational Fluid Dynamics. Comput. Electron.
539 Agric. 124, 84-99

540 Grandin, T. 1988. Behavior of slaughter plant and auction employees toward the animals.
541 Anthrozoös. 1(4), 205-213.

542 Grandin, T. 2014. Animal welfare and society concerns finding the missing link. Meat Sci. 98(3),
543 461-469.

544 Grandin, T., Shivley, C. 2015. How farm animals react and perceive stressful situations such as
545 handling, restraint, and transport. Animals. 5(4), 1233–1251.

546 Hadas, Y., Tillman, A., Rosenbloom, T., Rossi, R., Gastaldi, M. 2017. Drivers' attitude towards
547 caffeine chewing gum as countermeasure to driver task-related fatigue. Transp. Res. Proc.
548 22, 362-371.

549 Hansson, H., Lagerkvist, C.J. 2016. Dairy farmers' use and non-use values in animal welfare:
550 Determining the empirical content and structure with anchored best-worst scaling. J. Dairy
551 Sci. 99(1), 579-592.

552   Herskin, M. S., Hels, A., Anneberg, I., Thomsen, P.T. 2017. Livestock drivers' knowledge about
553   dairy cow fitness for transport–A Danish questionnaire survey. Res. Vet. Sci. 113, 62-66.

554   Ison, S., Rutherford, K.M.D. 2014. Attitudes of farmers and veterinarians towards pain and the use
555   of pain relief in pigs. Vet. J. 202, 622-627.

556   Kauppinen, T., Vesala, K. M., Valros, A. 2012. Farmer attitude toward improvement of animal
557   welfare is correlated with piglet production parameters. Livest Sci. 143(2), 142-150.

558   Kielland, C., Skjerve, E., Osterås, O., Zanella, A.J., 2010. Dairy farmer attitudes and empathy
559   toward animals are associated with animal welfare indicators. J. Dairy Sci. 93, 2998–3006.

560   Losada-Espinosa, N., Villarroel, M., María, G.A., Miranda-de la Lama, G.C. 2018. Pre-slaughter
561   cattle welfare indicators for use in commercial abattoirs with voluntary monitoring systems:
562   A systematic review. Meat Sci.138, 34-48.

563   Marahrens, M., Kleinschmidt, N., Di Nardo, A., Velarde, A., Fuentes, C., Truar, A., J.L. Otero,
564   J.C., Di Fede, E., Dalla Villa, P. 2011. Risk assessment in animal welfare–Especially
565   referring to animal transport. Prev. Vet. Med., 102(2), 157-163.

566   Mexican Institute for the Competitiveness A.C. 2017. Indice de Paz Mexico 2016.
567   http://imco.org.mx/seguridad/indice-de-paz-mexico-2016-via-el-instituto-para-la-
568   economia-y-la-paz/. (Accessed, Junuary 05, 2018).

569   Miranda-de la Lama, G.C., Sepulveda, W.S., Villarroel, M., María, G.A. 2011. Livestock vehicle
570   accidents in Spain: causes, consequences, and effects on animal welfare. J. Appl. Anim.
571   Welf. Sci. 14, 109–123.

572   Miranda-de la Lama, G.C., Leyva, I.G., Barreras-Serrano, A., Pérez-Linares, C., Sánchez-López,
573   E., María, G.A., Figueroa-Saavedra, F. 2012. Assessment of cattle welfare at a commercial
574   slaughter plant in the northwest of Mexico. Trop. Anim. Health. Prod. 44(3), 497-504.

575   Miranda-de la Lama, G.C., Villarroel, M,, María, G.A. 2014. Livestock transport from the
576   perspective of the pre-slaughter logistic chain: a review. Meat Sci. 98, 9–20.

577   Miranda-de la Lama, G. C., Estévez-Moreno, L. X., Sepúlveda, W. S., Estrada-Chavero, M. C.,
578   Rayas-Amor, A. A., Villarroel, M., María, G. A. 2017. Mexican consumers' perceptions and
579   attitudes towards farm animal welfare and willingness to pay for welfare friendly meat
580   products. Meat Sci. 125, 106-113.

581   Miranda-de la Lama, G.C., Estévez-Moreno, L.X., Villarroel, Rayas-Amor, A.A., María, G.A.,
582   Sepúlveda, W.S. 2018a. Consumer Attitudes Towards Animal Welfare Friendly Products

583 and Willingness to Pay: Exploration of Mexican Market Segments. J.. Appl. Anim. Welf.
584 Sci. In press.

585 Miranda-de la Lama, G.C., Rodríguez-Palomares, M., Cruz-Monterrosa, R.G., Rayas-Amor, A.
586 A., Pinheiro, R.S.B., Galindo, F. M., Villarroel, M. 2018b. Long-distance transport of hair
587 lambs: effect of location in pot-belly trailers on thermo-physiology, welfare and meat
588 quality. Trop. Anim. Health. Prod. 50, 327–336.

589 O'Kane, H., Ferguson, E., Kaler, J., Green, L. 2017. Associations between sheep farmer attitudes,
590 beliefs, emotions and personality, and their barriers to uptake of best practice: the example
591 of footrot. Prev. Vet. Med. 139, 123-133.

592 Pfrunder, A.A., Falk, A.C., Lindström, V. 2017. Ambulance personnel's management of pain for
593 patients with hip fractures; based on ambulance personnel's gender and years of experience.
594 Int. J. Orthop. Trauma. Nurs. 27, 23-27.

595 Pinillos, R.G., Appleby, M., Manteca, X., Scott-Park, F., Smith, C., Velarde, A. 2016. One
596 Welfare–a platform for improving human and animal welfare. Vet. Rec. 179, 412-413.

597 Probst, J.K., Neff, A.S., Hillmann, E., Kreuzer, M., Koch-Mathis, M., Leiber, F. 2014.
598 Relationship between stress-related exsanguination blood variables, vocalisation, and
599 stressors imposed on cattle between lairage and stunning box under conventional abattoir
600 conditions. Livest. Sci. 164, 154-158.

601 Pulido, M.A., Mariezcurrena-Berasain, M.A., Sepúlveda, W., Rayas-Amor, A.A., Salem, A.Z.M.,
602 Miranda-de la Lama, G.C. 2018. Hauliers' perceptions and attitudes towards farm animal
603 welfare could influence the operational and logistics practices in sheep transport. J. Vet.
604 Behav. 23, 25-32.

605 Ramírez-Romero, R., Ramírez-Hernández, C., García-Márquez, L.J., Macedo-Barragán, R.J.,
606 Martínez-Burnes, J., López-Mayagoitia, A. 2014. Bovine diseases causing neurological
607 signs and death in Mexican feedlots. Trop. Anim. Health. Prod., 46, 823-829.

608 Robbins, J.A., Franks, B., Weary, D.M., von Keyserlingk, M.A.G. 2016. Awareness of ag-gag
609 laws erodes trust in farmers and increases support for animal welfare regulations. Food
610 Policy. 61, 121-125.

611 Romero, M.H., Uribe-Velásquez, L.F., Sánchez, J.A., Rayas-Amor, A.A., Miranda-de La Lama,
612 G.C. 2017. Conventional versus modern abattoirs in Colombia: impacts on welfare

613　　　indicators and risk factors for high muscle pH in commercial Zebu young bulls. Meat Sci.
614　　　123, 173-181.

615 Schwartzkopf-Genswein, K.S., Haley, D.B., Church, S., Woods, J., Obyrne, T. 2008. An education
616　　　and training programme for livestock transporters in Canada. Vet. Ital. 44(1), 273-283.

617 SIAP. 2015. Bovino carne y leche: Poblacion ganadera 2006 – 2015.
618　　　https://www.gob.mx/cms/uploads/attachment/file/165997/bovino.pdf. (Accessed: 2018).

619 Small, A., Hewitt, L. 2017. Transport and pre-slaughter management. In Advances in Sheep
620　　　Welfare. 227-243.

621 Tao, D., Zhang, R., Qu, X. 2017. The role of personality traits and driving experience in self-
622　　　reported risky driving behaviors and accident risk among Chinese drivers. Accid. Anal. Prev.
623　　　99, 228-235.

624 Thomson, D.U., Loneragan, G. H., Henningson, J. N., Ensley, S., Bawa, B. 2015. Description of
625　　　a novel fatigue syndrome of finished feedlot cattle following transportation. J. Am. Vet.
626　　　Med. Assoc. 247(1), 66-72.

627 Vargas-Bello-Pérez, E., Miranda-de la Lama, G. C., Teixeira, D. L., Enríquez-Hidalgo, D., Tadich,
628　　　T., Lensink, J. 2017. Farm Animal Welfare Influences on Markets and Consumer Attitudes
629　　　in Latin America: The Cases of Mexico, Chile and Brazil. J. Agric. Environ. Ethics. 30(5),
630　　　697-713.

631 Versteeg, K., Amoli, T., Cao, M., Chin, M., Bigelow, P., Yazdani, A. 2018. Mixed-method
632　　　analysis of truck driver health knowledge using an online forum. Safety Sci. 102, 51-59.

633 Woods, J., Grandin, T. 2008. Fatigue: a major cause of commercial livestock truck accidents. Vet.
634　　　Ital. 44, 259–262.

635 Zhao, S., Liu, L., Chen, H. 2015. Factors influencing the occupational wellbeing of experienced
636　　　nurses. Int. J. Nurs. Sci. 2(4), 378-382.

Fig. 1. Design of the trailer used to transport livestock in Mexico. (1) Tip or nose; (2) belly; (3) backend; (4) deck; (5) doghouse or kitchen; (6) stairs; (7) back door; (8) roof.
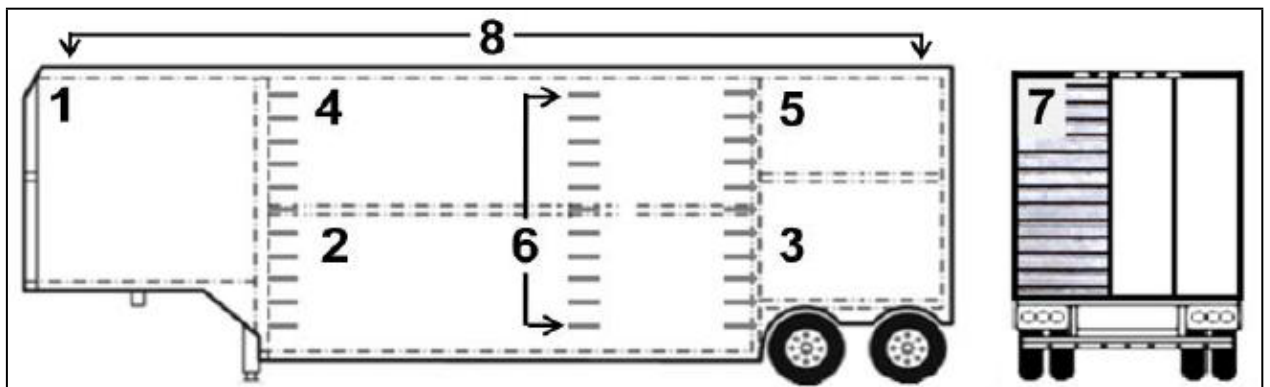
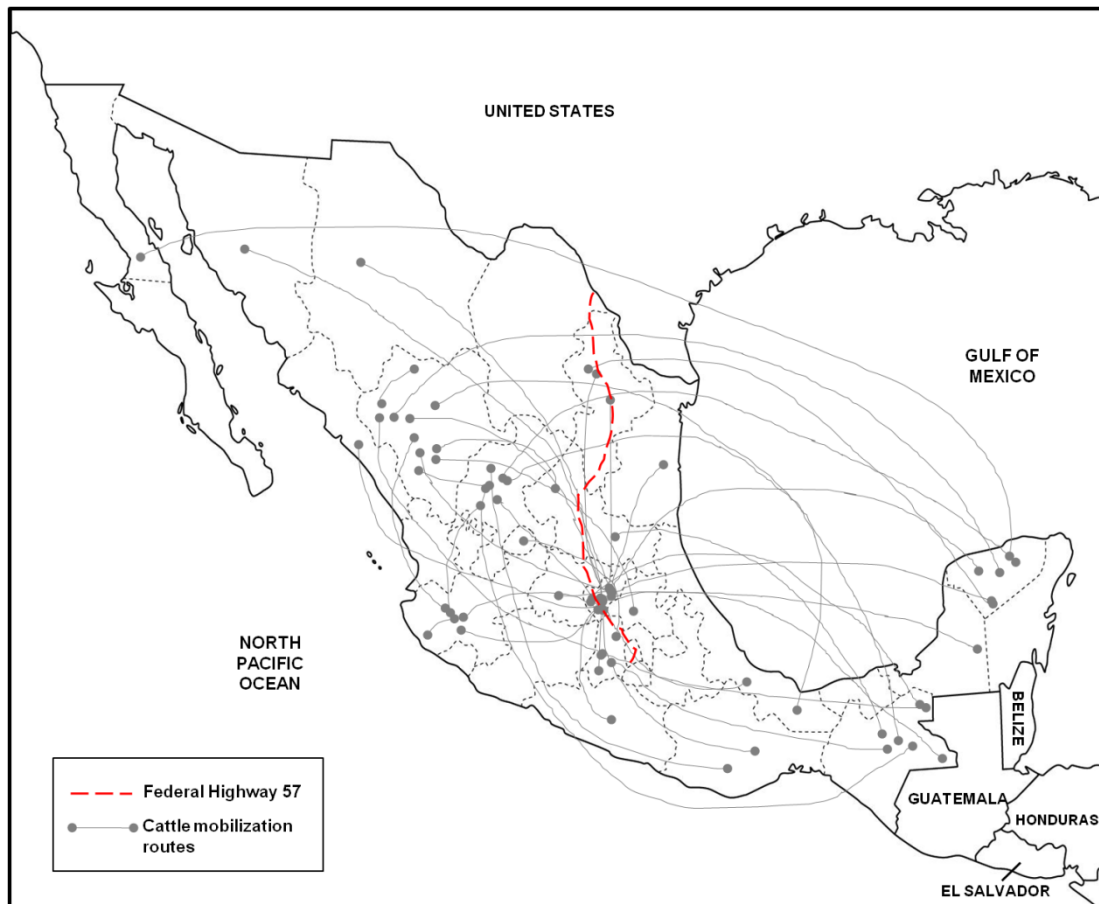**Fig. 2.** Cattle collection points and transport routes in different regions of Mexico.

Fig. 3. Influence of the hauliers' age on the time for cattle loading and unloading. Means with different lowercase letter differ (Kruskal-Wallis test, P <0.05).
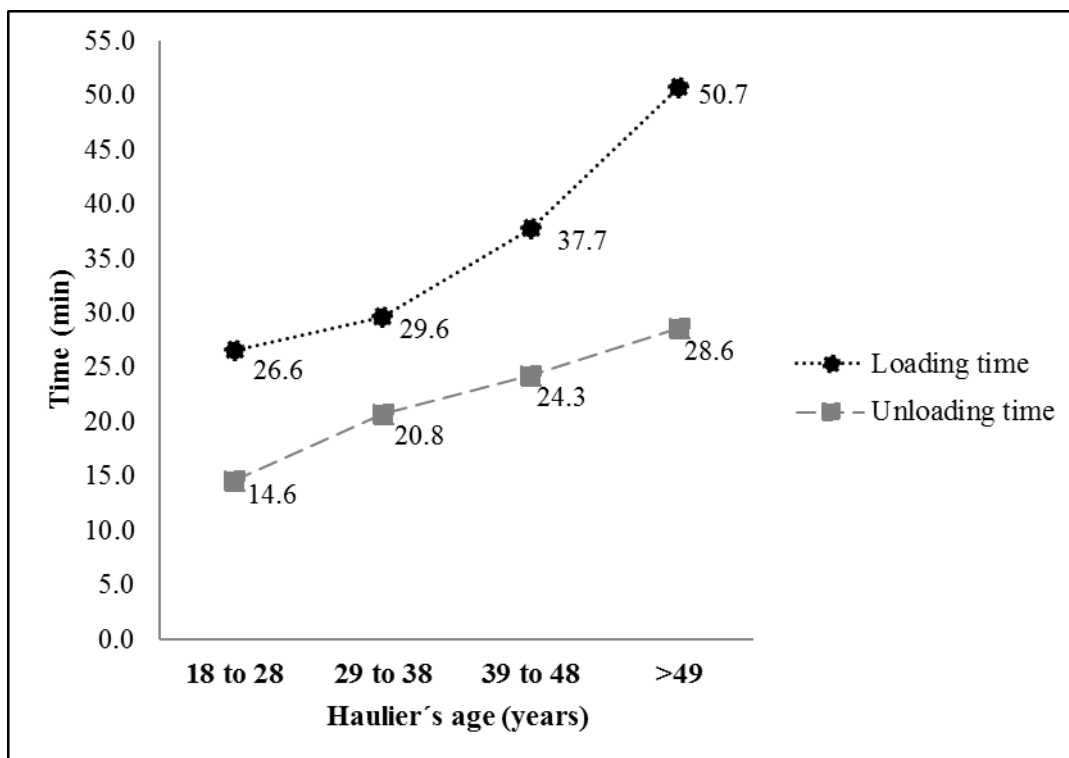
Table 1. Demographic characteristics of Mexican hauliers that participated in the survey, expressed as a percentage (n=74).

Haulier	n	%
Age (years-old)		
18-28	10	13.5
29-38	28	37.8
39-48	24	32.5
>49	12	16.2
Haulier education level		
Elementary school	15	20.3
Junior High-school	38	51.3
High school	21	28.4
Experience as driver of livestock trucks (years)		
1-3	8	10.8
4-6	16	21.6
7-10	14	19
>10	36	48.6
Who taught you, how to be a cattle haulier?		
A family member	36	49
A colleague at work	23	31
Other	15	20

Table 2. Hauliers' profiles based on perceptions and attitudes towards animal welfare, demographic characteristics and risk of accidents on road (n=71).

Variables	G1 (n=13)	G2 (n=14)	G3 (n=28)	G4 (n=16)	P
Attitudes and emotions towards farm animal welfare - ordinal scale of 5 points[1] – (Average)[a]					
Should cattle be able to express the natural behaviours of their species?	4.5	3.4	4.6	2.5	***
Are cattle capable of feeling pain?	5.0	4.8	5.0	4.9	*
Are cattle capable of feeling emotions (positive or negative)?	4.7	4.9	4.8	2.8	***
Opinions towards animal welfare - ordinal scale of 5 points[1] - (Average)[a]					
Do you think that in Mexico there is sufficient information about livestock welfare?	4.6	2.9	1.6	2.6	***
Do you think stress in livestock during production and transport affects the quality of the meat you consume?	4.7	1.4	4.7	4.0	***
Do you think that new laws on animal welfare are necessary to avoid abuses about management of animals during transport?	3.5	2.9	4.0	2.4	**
Demographic issues (Hauliers %)[b]					
Driving experience					
< 6 years	46.2	57.1	17.9	31.3	
> 6 years	53.9	42.9	82.2	68.7	*
Age (years-old)					
18-28	0.00	28.5	10.7	18.8	
29-38	38.5	42.9	35.7	43.7	N.S.
39-48	30.8	28.6	35.7	31.3	
>49	30.8	0.00	17.9	6.2	
Haulier education level					
Elementary school	23.1	14.3	17.9	25.0	
Junior High-school	61.5	57.1	46.4	50.0	N.S.
High school	15.8	28.7	35.7	25.0	
Accidents on road (Hauliers %)[b]					
Percentage of hauliers who suffered accidents	15.4	28.6	14.3	37.5	*
Percentage of drivers who think road accidents are the most important risk in their profession	7.7	35.7	39.3	62.5	*
Truck rollover is the most frequent accident (Percentage of hauliers)[a]	0.0	28.6	12.5	25.0	*

[1] Ordinal scale: 1 Surely not; 2 Probably not; 3 It does not matter to me; 4 Probably yes and 5 Definitely yes. P values correspond to Kruskal-Wallis (a) and Chi-squared (b) tests, N.S.: Not significant differences between the groups, *$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$.

Table 3. Logistic of cattle transport (350-450 kg live weight) in different regions of the country.

Cattle to be sent to feedlots or slaughterhouses	Collecting region		
	North	*Central*	*South*
Journeys for collecting cattle			
Number of drivers for each region *	9	18	74
Journeys for collecting cattle (%)	12.4	16.8	70.8
	Chihuahua	Querétaro	Chiapas
	Durango	Zacatecas	Tabasco
Main states for collecting cattle	Sonora	Jalisco	Veracruz
	Sinaloa	Aguascalientes	Yucatán
	Tamaulipas	Hidalgo	Oaxaca
Journey time for collecting cattle			
Total journey time (h)	53.9 ± 26.8	23.7 ± 13.4	71.6 ± 27.2
Journey time after cattle loading (h)	15.7 ± 5.7	10.8 ± 6.9	24.4 ± 11.3
*Stops during the journey after cattle loading (%) ** *			
1 a 3	0	27.8	6.8
4 a 6	33.3	38.9	29.7
≥ 7	66.7	33.3	63.5

* The same driver can go to different regions. **Stops at the animal health inspection and verification points (AHIP).