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Applicability of Gottingen Minipigs as a Non-Rodent Model in Biomedical Research

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Abstract

Use of Gottingen minipig as an animal model increased over years in the biomedical and toxicological industries due to the fact its anatomy and physiology is very similar to humans, and is prolific reproducers. Pigs used for various ailments that cannot be mimicked on rodent models. This is because minipigs possess physiological traits makes more comparable to human beings in countless ways. Pigs moreover considered 'standard' species in xenotransplantation research areas. On the contrary, the porcine immune system reported to be closer to human beings. Digestive, cardiovascular and urogenital system resembles the human systems, while the anatomy of the skin is very similar to the human skin. Gottingen minipig has contributed significantly to our understanding of disease and development of new therapies. The use of laboratory minipigs in biomedical research need good infrastructure animal facility, well suited animal husbandry practices and manipulation of different infectious pathogens are very important consideration.

Introduction

The Gottingen minipig used to be the first miniature pig breed to be developed in Europe from the late 1960's. The Gottingen minipig (also regarded as the Gottinger or Gottingen minipig) is a breed of small version swine. Gottingen minipig breeding character desires are low physique weight, extraordinary ear veins, and low inbreeding coefficients. Breeding resulted through the usage of crossing the Minnesota minipig procured from the Hormel Institute in the United States, and the Vietnamese pot-bellied pig, received from a German zoo. Subsequent, breeding with the German Landrace produced the white/ pink pores and skin pigmentation which characterizes the existing day Gottingen minipigs.

The Gottingen minipig is the smallest home pig breed stated in the world; as an adult, they weigh about only 35 kg. Average birth weight is 350-450 g and common litter size around 6 to 7. Besides being recognized for their small size, they are very docile in nature, smooth and well-characterized fitness status. Gottingen minipigs are particularly preferred as pets; however, the breed used to be as quickly as developed for biomedical research studies. minipigs requires much less space for house and less quantity of feed, had been tons much less hard to handle, and required a lesser quantity of the compound or anaesthetics are being tested (Figure 1).

Housing

Animal husbandry is the basic essential need for laboratory animals since they are very sensitive to minor changes in environmental parameters. Pigs are socialized animal as a result; they can be housed in small

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Figure 1: Gottingen Minipig

crew in the pen. The pens must comply with fundamental necessities concerning design, ground space, light, humidity, temperature, *etc*. Enrichment such as providing bedding material and toys which will enhance the animal welfare. When the Gottingen minipigs you have ordered arrive at the animal facility, kind the minipigs into pens setting apart adult males from females, in accordance to their unique pen numbers. Generally, housing of small group is preferred to prevent social deprivation. It is necessary to separate the pens with dividers from one pen to the others. Flooring format is also considerable. If strong substances are used it is recommended to make texture on the floor for secure footing and bedding ought to be supplied for rooting and nesting behaviour. Appropriate spacing between every bar is about 6~12 mm. If flooring did not wear hoof, the hoof needs to be trimmed every 60 to 90 days.

Detailed floor space requirement for animal house facility encouraged through AAALAC for mini pigs are given in Table 1. Optimum temperature range 16-27 °C, Light: 12 hours daily, 100-200 lux, Relative Humidity: 50-70%.

Table 1: Space requirement for pig recommended by AAALAC

Animal/ enclosure	Weight (kg)	Floor area animal^{-1} (m^2)
1	< 15	0.72
	Up to 25	1.08
	Up to 50	1.35
	Up to 100	2.16
2~5	< 25	0.54
	Up to 50	0.90
	Up to 100	1.80
> 5	< 25	0.54
	Up to 50	0.81
	Up to 100	1.62

(Source: National Research Council, 2010)

Temperature

The suitable comfortable zone of temperature can be measured at the floor level. When bedding material is used, the temperature can be decreased by using two degrees. Temperature reference range is given in Table 2.

Table 2: Reference ranges for environmental factors of Minipig facility

Age	Temperature (°C)
Less than one month	28
1-2 months	26
3-6 months	22-24
More than 6 months	20-22

(Source: Anonymous, 2010)

Environmental Enrichment

Environment enrichment is the provision of stimuli which promote the expression of species appropriate behavioural and mental activities in an under stimulating environment. Environmental enrichment is an essential from the animal welfare perspective point of view and it also helps to fulfil their basic primary needs. Prevention from responding to their natural inclinations could result in undue stress for the animal, possibly impacting their health and increasing stress-related hormone levels. Chains placing down to chunk in, ferret balls to play with and autoclaved straw or hay are considered perfect environmental enrichments.

Feeding

Minipigs are omnivores animal so their choice of choosing meals from variety of food sources. They can be fed with raw, all-natural form diet and commercially available pellet diet. Generally, under laboratory conditions the minipig is fed with commercially available pelleted diet with high-fibre, low-energy diets can be obtained from producers of dietary merchandise. Particularly the female Gottingen minipig need to be fed with weight-reduction feed diet to regulate the growth. Factors which have a direct impact on growth requirements consist of age, weight, gender, health status, activity, singular/ group housing, room temperature and air velocity. Males have a larger renovation requirement in distinction to females, which react to feeding or environmental adjustments through shedding weight faster than females.

Dietary energy requirement is needed to maintain the physical body temperature. Individually housed Minipigs normally use greater power for upkeep due to a lack of communal heat management. Heat loss through convection *via* the air or conduction through the flooring considered essential factors. Minipigs in housing with heated flooring, bedding or mats will require much less electricity in contrast to housed on cold flooring. Collectively housed Minipigs usually improve a hierarchy the place the strongest Minipig receives the most feed. This can be resolved by means of both keeping apart

the Minipigs when feeding or by using spreading the feed over a giant location of smooth floor. If housing consists of full slatted flooring, a rubber mat can be used for feeding. Minipigs younger than 7 months should require their daily amount of feed divided into two feeding intervals. Minipigs older than 7 months can be fed their daily amount of feed in one feeding only. Water ad libitum should made ought to be available. Water nipples need to be at the shoulder top so they solely elevate their head a little to drink. The peak of the nipples must be adjusted as the minipigs grow. In addition, to the formulated diet you can feed a good variety of fresh vegetables about 25% of the minipigs diet. Preferred vegetables such as carrots, potatoes, cucumbers, peppers, and green leaves are good choices. Some fruits can be feed as well but only in moderation due to their high sugar content. Minipigs love treats like apple, grapes, and raisins but these are good to serve as treats to be used in training. Total daily amount of food given in table 3.

Table 3: Total daily amount of food

Weight (kg)	Food for males (g)	Food for females (g)
5-9	240	220
9-13	240-300	220-280
13-17	300-340	280-320
17-21	340-380	320-360
21-25	380-420	360-400
25-35	420-600	400-600

(Source: Anonymous, 2010)

Research Documentation

The Gottingen Minipigs is successfully applied in dermal studies, oral studies, and continuous infusion studies. Also in local toxicity studies, by intra-lipomatous injection, the Gottingen minipig is a favourable model. Minipigs have been used as animal models for several clinical indicators such as cardiovascular, metabolic syndromes, digestive and bone disorders, diabetes, heart disease, skin conditions, acute and chronic intestinal inflammation (Stricker-Krongrad *et al.*, 2016).

Specific Pathogen Free (SPF) Condition

The below mentioned bacteria, fungal and viral diseases are very common in miniature Gottingen minipigs. In order to produce good quality animals for studies animals should free from below mentioned pathogen which can be periodically monitored using sentinel animals (McAnulty *et al.*, 2012). Bacterial diseases like *Actinobacillus pleuropneumoniae*, *Bordetella bronchiseptica*, *Brachyspira* spp., *Campylobacter* spp., *Clostridium* spp., *Erysipelothrix* spp., *Haemophilus parasuis*, *Leptospira* spp., *Listeria* spp., *Mycoplasma* spp., *Pasteurella* spp., *Salmonella* spp., *Staphylococcus hyicus*, *Streptococcus* spp., *Yersinia* spp., Fungal diseseas like *Candida* spp., *Microsporum* spp. and *Trichophyton* spp. Viral diseases like Aujeszky's disease, Encephalomyocarditis virus, Hemagglutinating encephalomyelitis, Transmissible gastroenteritis, Porcine circovirus, Porcine epidemic diarrhea, Porcine influenza, Porcine parvovirus, Porcine reproductive & respiratory syndrome, Porcine rotavirus and Swine fever.

Conclusion

Use of Gottingen minipigs as a laboratory animal model can provide tremendous improvement for the development of acquiring scientific knowledge in biomedical research and toxicological studies since they share anatomical and physiological characters are very similar to humans and they are easy to handle and maintain under laboratory condition without any difficulty. However, proper animal facility management and good animal husbandry practices plays major day to day activities in conducting animal research studies. In addition to this, considering animal welfare is another important issue in this research field.

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