

# Effects of Caging Systems on Animal Welfare, Work Environment and Study Outcome

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Different cage systems can be used to house laboratory rodents, in the table below three of these are compared by categorizing into various categories.

### Categories:

- ÷ Negative effect of cage type in this relation
- Indifferent effect of cage type in this relation
- + Positive effect of cage type in this relation
- < Decreased factor compared to other cage types
- > Increased factor compared to other cage types.

Table 1: A comparison of three aging systems: Open cage (also known as conventional cage), ScanTainer (also known as cabinet), and Individually Ventilated Cages (IVC). **Abbreviations:** ACH: Air changes per hour, IVC: Individually ventilated cages, O<sub>2</sub>: Oxygen, NA: Non-Available, NH<sub>3</sub>: Ammonia, and RH: Relative humidity.

Topic	Open cage	ScanTainer	IVC	Source
<b>Cage environment</b>				
Light	Rats with coverage and limited light is less anxious and stressed.			[1]
	+/÷	+	+/÷	
Light	Light exposure impairs retinal function and structure in rats.			[2-5]
	+/÷	+	+/÷	
Sounds	Chronic ultrasound exposure influence behavior, impair memory and lead to depressive like behavior.			[6-8]
	÷	+	+	
Sounds	Chronic noise change animal body weight, influence behavior, serum concentrations, and gut microbiota composition. However, exposure to moderate levels of noise do not alter the welfare of mice			[9, 10]
	-	-	-	
Smell	Smells are important for social recognition, social cue processing, and communication. Therefore, ability to smell neighbors may increase welfare, but could also influence observational results.			[11, 12]
	+/÷	+/÷	+/÷	
Draught	Mice show preference for cages without draught and IVC cages with air supply in the top of the cage. Air inlet at the level of the mice show a negative effect on body weight and a			[13-16]

	relation to anxiety related behavior. Rats have shown less susceptible to air speed than mice, however high number of ACH can affect heart rate and systolic blood pressure.	
	NA	NA
		+/ $\div$
NH <sub>3</sub>	IVC keep NH <sub>3</sub> levels low both in cages and in the stable for at least 7 days independent of position of the cage in rack.	[17-20]
	$\div$	NA
		+/ $<$ NH <sub>3</sub>
O <sub>2</sub>	IVC above 50 ACH does not influence O <sub>2</sub> air concentrations or red blood cell count.	[21-23]
	-	-
Particles	IVC decrease particle levels in the cages both at low and medium ACH.	[17]
	-	NA
		+
RH	IVC increase RH within the cages both at low and high ACH.	[17, 21]
	-	-
		+/ $\div$
Temperature	IVC increase temperature within the cages (1-2 degrees).	[17, 24]
	-	-
		<b>&gt; Temperature</b>
<b>Microbiota</b>		
Microbiota	IVC can be used for at least four weeks without influencing the microbiota of germ-free mice (alternative to gnotobiotic isolators).	[25, 26]
	NA	NA
		+
<b>Inflammation</b>		
Inflammation	IVC decrease inflammation in mice and female rats.	[20, 27]
	<b>&gt; inflammation</b>	NA
		<b>&lt; inflammation</b>
<b>Behavior</b>		
Isolation	Females prefer smelling, hearing, and seeing familiar rats when physically isolated. Males seem indifferent to short term isolation but develop depressive-anxiety like behavior after 6 weeks of isolation.	[28-31]
	+	+
		$\div$
Anxiety	Cage types does not affect anxiety in mice, except for C57Bl/6J mice, which have decreased anxiety in IVC cages.	[24, 32]
	-	-
		<b>&lt; Anxiety</b>
Locomotion	Caging types does not affect locomotion in mice.	[21, 24, 32]
	-	-
		-
Body weight	Caging types does not influence weight gaining.	[24, 27]
	-	-
		<b>-/<math>&gt;</math> body weight</b>

Work environment			
Work environment	Ventilated husbandry solutions reduce levels of airborne allergen substantially at negative pressure but can be ergonomically less suitable. With IVC systems having the lowest ergonomic score in this comparison.		[33]
	÷	+	+(÷ ergonomic)
	Allergen spread and exposure is high within stables and animal facilities with open cages. However, this is minimized in facilities using IVC (especially with negative pressure).		[34, 35]
	÷	NA	+
	Medium to high allergen exposure is observed during cage changing and washing. Cage-changing stations is advised.		[35]
	÷	NA	+

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