



Bibliography on Refined Identification Methods in Mice and Rats in Research

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Alternatives and Refined Methods for Rodent Identification

Traditional methods of identifying rodents in research, such as ear tagging, ear notching, and toe clipping are not the only methods available to identify rodents. Several potentially less distressing or painful methods exist, such as dyeing, tattooing, and microchipping. Utilizing less invasive methods of rodent identification is considered a refinement method that furthers the objective of the 3Rs (replacement, reduction and refinement of animals used in research).

Bibliography

This bibliography includes citations on refined methods of identifying mice and rats. The bibliography covers articles published from 2004 to 2024.

The following databases were searched:

- PubMed
- Embase
- Web of Science (All databases: Web of Science Core Collection and Biological Abstracts, BIOSIS Science Citation Index, Current Contents Concept, KCI-Korean Journal Database, Russian Science Citation Index, SciELO Citation Index, and Zoological Record)
- EBSCO (Agricola, CAB Abstracts, eBook Collection (EBSCOhost), Environment Complete, Global Health, Zoological Record, Biological Abstracts)

The citations are arranged in alphabetical order by the last name of the first author. We have omitted abstracts due to publisher copyright considerations. The search strategies that we used in these searches are provided following the citations.

Finding Abstracts and Full-Text of Articles

We have omitted abstracts due to publisher copyright considerations. However, you can locate abstracts easily by clicking on the DOI (digital object identifier) in the citation. The DOI is a permanent identifier that links to the journal article's page on the journal's website.

There are multiple ways of locating full-text articles and books in the bibliography. You can check the National Agricultural Library’s (NAL) online catalog, [SEARCH](#), to see which books and periodicals the library has in its holdings. Some online periodicals in NAL’s holdings are only available to USDA employees through the [Digitop](#) portal. Other articles are open access and may be downloaded for free. If you are not a USDA employee, check with your local or institutional library to see whether your library subscribes to these periodicals or can order them on interlibrary loan.

Information on how to request materials that are included in the National Agricultural Library (NAL)’s collections can be found on the [Request Library Materials](#) page. USDA employees can request books and articles through Document Delivery. All patrons are encouraged to explore local library resources first before contacting the National Agricultural Library. If you are not a USDA employee, you may visit the library during its hours of operation to request items or read electronic articles on-site. You may also request items on interlibrary loan through your home library (check with your institutional, university, or public library’s loan office for further information).

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Citations on Refined Identification Methods in Mice

Citations:

21 citations

Burn, C. C., Mazlan, N. H. B., Chancellor, N., & Wells, D. J. (2021). The Pen Is Milder Than the Blade: Identification Marking Mice Using Ink on the Tail Appears More Humane Than Ear-Punching Even with Local Anaesthetic. *Animals : An Open Access Journal from MDPI*, 11(6). <https://doi.org/10.3390/ani11061664>

Cameron, J., Jacobson, C., Nilsson, K., & Rögnvaldsson, T. (2007). A biometric approach to laboratory rodent identification. *Lab Animal*, 36(3), 36–40. <https://doi.org/10.1038/lab0307-36>

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Strategy:

PubMed

1. (Mice[MeSH Major Topic] OR mouse[Title] OR mice[Title] OR mus[Title] OR murine[Title] OR rodent*[Title]) AND ("Animal Identification Systems"[Mesh Major Topic] OR (identification[Title] AND (method*[Title] OR technique*[Title] OR system[Title]))) OR microchip*[Title] OR dye[Title] OR tattoo*[Title] OR (band*[Title] OR tag[Title] OR marker*[Title] OR ring*[Title] OR collar*[Title] OR flag*[Title] OR notch*[Title] OR punch*[Title] OR clip*[Title] AND (leg[Title] OR neck[Title] OR foot[Title] OR ear[Title] OR tail[Title] OR toe[Title]))) AND (Animal Use Alternatives[MeSH Terms] OR "Animal Welfare"[Mesh] OR noninvasive[Title/Abstract] OR non-invasive[Title/Abstract] OR "minimally invasive"[Title/Abstract] OR "less invasive"[Title/Abstract] OR less-aversive[Title/Abstract] OR non-aversive[Title/Abstract] OR welfare[Title/Abstract] OR "well-being"[Title/Abstract] OR stress*[Title/Abstract] OR refine*[Title/Abstract] OR distress*[Title/Abstract] OR 3Rs[Title/Abstract] OR "three rs"[Title/Abstract] OR "animal use alternative*" [Title/Abstract] OR alternative*[Title/Abstract] OR humane[Title/Abstract] OR "stress-free"[Title/Abstract] OR "low stress"[Title/Abstract] OR "reduce stress"[Title/Abstract] OR pain*[Title/Abstract] OR anxiety[Title/Abstract] OR "best method*" [Title/Abstract] OR "best practice*" [Title/Abstract] OR "preferred method*" [Title/Abstract] OR recommend*[Title/Abstract] OR guideline*[Title/Abstract]) AND ("2004"[Date - Publication] : "2024"[Date - Publication])

Embase

1. (Mouse/exp/mj OR (mouse OR mice OR mus OR murine OR rodent*):ti) AND ('animal identification'/exp/mj OR (microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR (band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip* AND (leg OR neck OR foot OR ear OR tail OR toe))):ti) AND ('Animal Welfare'/exp/mj OR (noninvasive OR non-invasive OR 'minimally invasive' OR 'less invasive' OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR 'three rs' OR 'animal use alternative*' OR alternative* OR humane OR stress-free OR 'low stress' OR 'reduce stress' OR pain* OR anxiety OR 'best method*' OR 'best practice*' OR 'preferred method*' OR recommend* OR guideline*):ab,ti) AND [2004-2024]/py

Web of Science

1. (TI=(mouse OR mice OR mus OR murine OR rodent*)) AND (TI=(microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR (band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip* AND (leg OR neck OR foot OR ear OR tail OR toe)))) AND (TI=(noninvasive OR non-invasive OR "minimally invasive" OR "less invasive" OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR "three rs" OR "animal use alternative*" OR alternative* OR humane OR stress-free OR "low stress" OR "reduce stress" OR pain* OR anxiety OR "best method*" OR "best practice*" OR "preferred method*" OR recommend* OR guideline*)) AND (PY=(2004-2024))

EBSCO (Biological Abstracts, Agricola, CAB Abstracts, eBook Collection (EBSCOhost), Global Health, Zoological Record)

1. (TI (mouse OR mice OR mus OR murine OR rodent*)) AND (TI (microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR (band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip* AND (leg OR neck OR foot OR ear OR tail OR toe)))) AND (TI (noninvasive OR non-invasive OR "minimally invasive" OR "less invasive" OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR "three rs" OR "animal use alternative*" OR alternative* OR humane OR stress-free OR "low stress" OR "reduce stress" OR pain* OR anxiety OR "best method*" OR "best practice*" OR "preferred method*" OR recommend* OR guideline*))
Limiters: Date Published 2004-2024

Citations on Refined Identification Methods in Rats

Citations:

7 citations

Burn, C. C., Deacon, R. M. J., & Mason, G. J. (2008). Marked for life? Effects of early cage-cleaning frequency, delivery batch, and identification tail-marking on rat anxiety profiles. *Developmental Psychobiology*, 50(3), 266–277. <https://doi.org/10.1002/dev.20279>

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Isken, M. T., Sen, C., Ozgentaş, H. E., & Iscen, D. (2008). An alternative animal marking method: Use of hair-dye. *Gazi Medical Journal*, 19(2), 71–72. Embase.

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Nguyen, L. D., & Lima, L. M. (2015). Evaluation of animal identification methods for SPF high-throughput animal vivariums. *Journal of the American Association for Laboratory Animal Science*, 54(5), 601–602. Embase.

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<https://doi.org/10.1038/s41598-023-50343-6>

Strategy:

PubMed

1. (Rats[Mesh] OR rat[title/abstract] OR rats[title/abstract] OR rattus*[title/abstract] OR "r norvegicus"[title/abstract]) AND ("Animal Identification Systems"[Mesh Major Topic] OR (identification[title/abstract] AND (method*[title/abstract] OR technique*[title/abstract] OR system[title/abstract]))) OR microchip*[title/abstract] OR dye[title/abstract] OR tattoo*[title/abstract] OR (band*[title/abstract] OR tag[title/abstract] OR marker*[title/abstract] OR ring*[title/abstract] OR collar*[title/abstract] OR flag*[title/abstract] OR notch*[title/abstract] OR punch*[title/abstract] OR clip*[title/abstract] AND (leg[title/abstract] OR neck[title/abstract] OR foot[title/abstract] OR ear[title/abstract] OR tail[title/abstract] OR toe[title/abstract])))) AND (Animal Use Alternatives[MeSH Terms] OR "Animal Welfare"[Mesh] OR noninvasive[Title/Abstract] OR non-invasive[Title/Abstract] OR "minimally invasive"[Title/Abstract] OR "less invasive"[Title/Abstract] OR less-aversive[Title/Abstract] OR non-aversive[Title/Abstract] OR welfare[Title/Abstract] OR "well-being"[Title/Abstract] OR stress*[Title/Abstract] OR refine*[Title/Abstract] OR distress*[Title/Abstract] OR 3Rs[Title/Abstract] OR "three rs"[Title/Abstract] OR "animal use alternative*" [Title/Abstract] OR alternative*[Title/Abstract] OR humane[Title/Abstract] OR "stress-free"[Title/Abstract] OR "low stress"[Title/Abstract] OR "reduce stress"[Title/Abstract] OR pain*[Title/Abstract] OR anxiety[Title/Abstract] OR "best method*" [Title/Abstract] OR "best practice*" [Title/Abstract] OR "preferred method*" [Title/Abstract] OR recommend*[Title/Abstract] OR guideline*[Title/Abstract]) AND ("2004"[Date - Publication] : "2024"[Date - Publication])

Embase

1. (rat/exp/mj OR (rat OR rats OR rattus OR 'r norvegicus*'):ab,ti) AND ('animal identification'/exp/mj OR (microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR (band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip* AND (leg OR neck OR foot OR ear OR tail OR toe))):ti,ab) AND ('Animal Welfare'/exp/mj OR (noninvasive OR non-invasive OR 'minimally invasive' OR 'less invasive' OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR 'three rs' OR 'animal use alternative*' OR alternative* OR humane OR stress-free OR 'low stress' OR 'reduce stress' OR pain* OR anxiety OR 'best method*' OR 'best practice*' OR 'preferred method*' OR recommend* OR guideline*):ab,ti) AND [2004-2024]/py

Web of Science

1. (TI=(rat OR rats OR rattus* OR "r norvegicus*") OR AB=(rat OR rats OR rattus* OR "r norvegicus*")) AND (TI=(microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR ((band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip*) AND (leg OR neck OR foot OR ear OR tail OR toe))) OR AB=(microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR ((band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip*) AND (leg OR neck OR foot OR ear OR tail OR toe)))) AND (TI=(noninvasive OR non-invasive OR "minimally invasive" OR "less invasive" OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR "three rs" OR "animal use alternative*" OR alternative* OR humane OR stress-free OR "low stress" OR "reduce stress" OR pain* OR anxiety OR "best method*" OR "best practice*" OR "preferred method*" OR recommend* OR guideline*)) AND (PY=(2004-2024))

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Citations on Refined Identification Methods in Rodents

Citations:

4 citations

Cameron, J., Jacobson, C., Nilsson, K., & Rögnvaldsson, T. (2007). A biometric approach to laboratory rodent identification. *Lab Animal*, 36(3), 36–40.

<https://doi.org/10.1038/lab0307-36>

Dahlborn, K., Bugnon, P., Nevalainen, T., Raspa, M., Verbost, P., & Spangenberg, E. (2013). Report of the Federation of European Laboratory Animal Science Associations Working Group on animal identification. *Laboratory Animals*, 47(1), 2–11.

<https://doi.org/10.1177/002367712473290>

Klabukov, I., Shestakova, V., Krasilnikova, O., Smirnova, A., Abramova, O., Baranovskii, D., Atiakshin, D., Kostin, A. A., Shegay, P., & Kaprin, A. D. (2023). Refinement of Animal Experiments: Replacing Traumatic Methods of Laboratory Animal Marking with Non-Invasive Alternatives. *Animals : An Open Access Journal from MDPI*, 13(22).

<https://doi.org/10.3390/ani13223452>

Wever, K. E., Geessink, F. J., Brouwer, M. A. E., Tillema, A., & Ritskes-Hoitinga, M. (2017). A systematic review of discomfort due to toe or ear clipping in laboratory rodents. *Laboratory Animals*, 51(6), 583–600. <https://doi.org/10.1177/0023677217705912>

Strategy:

PubMed

1. ("Rodentia"[Mesh] OR rodent*[title/abstract]) AND ("Animal Identification Systems"[Mesh Major Topic] OR (identification[title/abstract] AND (method*[title/abstract] OR technique*[title/abstract] OR system[title/abstract]))) OR microchip*[title/abstract] OR dye[title/abstract] OR tattoo*[title/abstract] OR (band*[title/abstract] OR tag[title/abstract] OR marker*[title/abstract] OR ring*[title/abstract] OR collar*[title/abstract] OR flag*[title/abstract] OR notch*[title/abstract] OR punch*[title/abstract] OR clip*[title/abstract] AND (leg[title/abstract] OR neck[title/abstract] OR foot[title/abstract] OR ear[title/abstract] OR tail[title/abstract] OR toe[title/abstract])))) AND (Animal Use Alternatives[MeSH Terms] OR "Animal Welfare"[Mesh] OR noninvasive[Title/Abstract] OR non-invasive[Title/Abstract] OR "minimally invasive"[Title/Abstract] OR "less invasive"[Title/Abstract] OR less-aversive[Title/Abstract] OR non-aversive[Title/Abstract] OR welfare[Title/Abstract] OR "well-being"[Title/Abstract] OR stress*[Title/Abstract] OR refine*[Title/Abstract] OR distress*[Title/Abstract] OR 3Rs[Title/Abstract] OR "three rs"[Title/Abstract] OR "animal use alternative*" [Title/Abstract] OR alternative*[Title/Abstract] OR humane[Title/Abstract] OR "stress-free"[Title/Abstract] OR "low stress"[Title/Abstract] OR "reduce

stress"[Title/Abstract] OR pain*[Title/Abstract] OR anxiety[Title/Abstract] OR "best method*" [Title/Abstract] OR "best practice*" [Title/Abstract] OR "preferred method*" [Title/Abstract] OR recommend*[Title/Abstract] OR guideline*[Title/Abstract]) AND ("2004"[Date - Publication] : "2024"[Date - Publication])

Embase

1. ('rodent'/exp OR (rodent*):ti,ab) AND ('animal identification'/exp/mj OR (microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR (band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip* AND (leg OR neck OR foot OR ear OR tail OR toe))):ti,ab) AND ('Animal Welfare'/exp/mj OR (noninvasive OR non-invasive OR 'minimally invasive' OR 'less invasive' OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR 'three rs' OR 'animal use alternative*' OR alternative* OR humane OR stress-free OR 'low stress' OR 'reduce stress' OR pain* OR anxiety OR 'best method*' OR 'best practice*' OR 'preferred method*' OR recommend* OR guideline*):ab,ti) AND [2004-2024]/py

Web of Science

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EBSCO (Biological Abstracts, Agricola, CAB Abstracts, eBook Collection (EBSCOhost), Global Health, Zoological Record)

1. (TI (rodent*) OR AB (rodent*)) AND (TI (microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR ((band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip*) AND (leg OR neck OR foot OR ear OR tail OR toe))) OR AB (microchip* OR dye OR tattoo* OR (identification AND (method* OR technique* OR system)) OR ((band* OR tag OR marker* OR ring* OR collar* OR flag* OR notch* OR punch* OR clip*) AND (leg OR neck OR foot OR ear OR tail OR toe)))) AND (TI (noninvasive OR non-invasive OR "minimally invasive" OR "less invasive" OR less-aversive OR non-aversive OR welfare OR well-being OR stress* OR refine* OR distress* OR 3Rs OR "three rs" OR "animal use alternative*" OR alternative* OR humane OR stress-free OR "low stress" OR "reduce

stress" OR pain* OR anxiety OR "best method*" OR "best practice*" OR "preferred method*" OR recommend* OR guideline*))

Limiters - Publication Date: 2004-204