

Journal of Animal Science Style and Form (Revised 2002)^{a,b}

EDITORIAL POLICIES AND PROCEDURES

The mission of the American Society of Animal Science (ASAS) is to foster communication and collaboration among individuals and organizations associated with animal science research, education, industry, or administration. The *Journal of Animal Science (JAS)*, which is published monthly by ASAS, accepts manuscripts presenting information for publication with this mission in mind. Its editorial policies are established by the editor-in-chief, publications director, technical editor, section editors, and editorial board, subject to review by the publications committee, board of directors, and the membership of ASAS.

Views expressed in papers published in *JAS* represent the opinions of the author(s) and do not necessarily reflect the official policy of the institution with which the author is affiliated, ASAS, or the editor-in-chief.

The *JAS* is one of the most frequently cited peer-reviewed, agriculturally oriented research journals in the world, based on statistics published by the Institute for Scientific Information, Inc. (Philadelphia, PA). Its high impact factor attests to the quality standards maintained by the *JAS* editorial board and by authors who submit manuscripts for publication.

Electronic Publication

The *Journal of Animal Science* is published as a full journal electronically on the Internet in addition to being published as a paper journal. The journal is published in PDF format viewable with Adobe's Acrobat Reader. Access to the journal electronically is via the ASAS Web site (<http://www.asas.org>). Members can elect not to subscribe to the paper journal but have access to the full journal electronically by paying only their membership fee. Articles published in electronic format will be posted before the paper journal is printed and will retain the same citation as the paper version.

Care and Use of Animals

All manuscripts submitted to *JAS* must be accompanied by a manuscript submission form certifying that

any research that involves animals has followed established standards for the humane care and use of animals. Only investigations that have followed high standards for the humane care and use of animals in research will be reported in *JAS*. Before conducting experiments with animals, scientists should give careful consideration to the use of *in vitro* techniques or other alternatives. The appropriateness of the animal species and the minimum number of animals needed to meet scientific and statistical standards also should be considered. All research animals shall be acquired, retained, and used in compliance with federal, state, and local laws and regulations. Animals used in research must receive proper housing, feed, and care to ensure their comfort and health. If research requires discomfort to the animals or stressful conditions, justification for these conditions must be evident in papers published in *JAS*. The manuscript should discuss anesthetics, analgesics, tranquilizers, and care taken to minimize pain and discomfort during preoperative, operative, and postoperative procedures. Procedures used shall be those of accepted veterinary medical practice. If the study or condition of the animal requires that the animal be killed, a humane method shall be used. All animals used in experiments shall be under the direct supervision of an experienced investigator.

Types of Articles

Research Articles. Results of work contained in manuscripts submitted to *JAS* must not have been published previously in a refereed scientific journal. Previous presentation at a scientific meeting or the use of data in field day reports or similar documents, including press publications or postings to personal or departmental Web sites, does not preclude the publication of such data in *JAS*. Articles simultaneously posted to Web sites and submitted to *JAS* should carry a disclaimer on the Web site that this version of the paper has not undergone *JAS* peer-review and is not to be considered the final published form of the article. If the article is published in *JAS*, we ask that you post the PDF version of the article to your Web site so proper credit can be given to *JAS* as the publisher of the article. Because *JAS* holds the copyright to articles it publishes, posting altered *JAS* articles that are represented as exact duplicates of the published version constitutes copyright violation. Authors are discouraged from submitting manuscripts based on routine, repetitive product testing, especially if it is derived from a single station report that is part of a wide-scale commercial efficacy trial.

^aItems in boldface are changes or additions to the previous version.

^bThese guidelines are also available from the ASAS Web site (<http://www.asas.org>).

Review Articles. Occasionally proposals for review articles to be published in *JAS* may be solicited by section editors, after consultation with the editor-in-chief. Unsolicited review articles, however, will not be considered for publication.

Contemporary Issues and Teaching Papers. Papers that present positions dealing with issues of contemporary interest to animal scientists or with teaching will be considered for publication in the Contemporary Issues and Teaching sections of the *Journal*. Contemporary issues may include matters such as environmental concerns, legislative proposals, and systems analysis. Teaching papers may discuss innovative pedagogical methods, philosophy of education, or solutions to teaching problems in animal science. They do not have to include original data, although whenever appropriate stated assertions should be substantiated by references to established information from credible published sources. Contemporary Issues and Teaching papers should be submitted as outlined under GUIDELINES FOR AUTHORS for Manuscript Submission and will be subject to peer review in a manner similar to other submissions. Because of the nature of these papers, their format may vary from that of standard scientific articles based on original research.

Technical Notes. A technical note is a vehicle to report a new method, technique, or procedure of interest to *JAS* readers. When possible, a technical note should include a comparison of results from the new method with those from previous methods, using appropriate statistical tests. When typeset, a technical note shall not exceed six pages (nine typed manuscript pages), including tables and figures. The advantages and disadvantages of the new procedure should be discussed. The words "Technical Note" shall be the first words of the title of such manuscripts. The review process for a technical note will be the same as that for other manuscripts.

Letters to the Editor. Letters judged suitable for publication will be printed in a "Letters to the Editor" section of the *Journal*. The purpose of this section is to provide a forum for scientific exchange relating to matters published in the *Journal*. To be acceptable for publication, letters must adhere to the following guidelines: 1) Only letters that address matters of science and relate to information published in the *Journal* will be considered. In general, letters should not exceed 5,000 characters plus spaces and should not contain more than five citations. 2) Letters must provide supporting evidence based on published data for the points made or must develop logical scientific hypotheses; letters based on conjecture or on unsubstantiated claims will not be published. No new data may be presented in the letters. 3) Letters will be considered by the editor-in-chief and if deemed appropriate for publication, the author(s) of original paper(s) will be invited to write a letter of response. Normally both letters will be published together. 4) All letters will be subject to acceptance by

the editor-in-chief and to editing by the editor-in-chief and the technical editor.

Biographical and Historical Sketches

Biographical and Historical Sketches will be published on the ASAS Web site. Frequency of publication is dependent on the availability of the prepared sketches. Guidelines for identifying biographees and publishing biographical sketches are as follows:

1. The nominee must be deceased.
2. The nominee must have been an active member of ASAS (formerly ASAP).
3. The nominee must have made major contributions to the livestock industry and to the Society during active membership.
4. The noteworthy contributions must have been in any phase of animal production, including teaching, research, extension, or administration, or combinations thereof, in academics, government, or private industry.
5. Nominations can be made by any active member of ASAS at any time to the section editor for Biographical Sketches. Acceptance or rejection of the nomination will be made by the board of directors of ASAS.
6. The sketch will have a maximum length of 18,000 characters plus spaces.
7. The submitted sketch will be reviewed by members of the Biographical Sketch Committee and(or) outside reviewers as appropriate.
8. Accepted sketches will be subject to the normal editorial process and each sketch along with a photograph of the biographee will be published online.

Historical sketches are intended to survey the history of some aspect of animal science research in order to educate readers about the scope of or progress in a specific field. For instance, sketches might be written about the development of a specific laboratory technique or instrumentation, the gradual rise to prominence of a research group or laboratory, or the history of research into one particular group of nutrients. Historical sketches should be limited to a single, well-defined topic that can be described using specific examples and supportive references. Although discussions of individual scientists should not be ignored when they are relevant, historical sketches should focus on the development of an idea or procedure, rather than on an individual researcher, for whom a biographical sketch is more appropriate.

The Review Process

The suitability of manuscripts for publication in *JAS* is judged by reviewers, section editors, and the editor-in-chief. The editor-in-chief, the section editors, and most reviewers are members of the editorial board.

Three-year appointments to the editorial board are made by the Board of Directors of ASAS. Appointments to the editorial board are guided by the needs of the editorial board for individuals with particular scientific knowledge within a given field of specialization. Members of the editorial board are chosen on the basis of demonstrated expertise and editorial competence. Duties of the editor-in-chief and section editors are described in the ASAS handbook.

Section editors have full responsibility for review of manuscripts assigned to them. They select two or more individuals, members of the editorial board or other qualified reviewers, to review each manuscript. Reviewers or section editors may not be from the same institution as authors. The section editor will contact potential reviewers before forwarding manuscripts to them for review. Reviewers maintain confidentiality of the information presented in the manuscript and recommend acceptance, rejection, or acceptance after revision. Reviewers should render their opinions in an unbiased and ethical manner, provide helpful guidance for authors in a written form, and return the manuscript to the section editor within 3 wk. If the section editor seeks additional advice, the review process may take longer. Section editors handle correspondence with the author and promptly advise the editor-in-chief whether the manuscript should be accepted or rejected. The section editors notify the authors of the recommendation to the editor-in-chief. The editor-in-chief's decision to accept or reject the paper is based on the section editor's recommendation and his or her own review of the article.

Criteria for Rejecting Manuscripts

There are three main grounds for rejection of manuscripts. First, the substance of the manuscript may not meet *JAS* standards: The work may be incomplete, the evidence may not support the conclusions, or the experimental approach may be poorly conceived. **Manuscripts that do not conform to *JAS Style and Form* guidelines or that are not written in fluent English will be rejected immediately without review.** Second, although the work may be sound and the results valid, the paper may be better suited for publication elsewhere. Third, the work may repeat established fact or represent no advance of existing knowledge. If a manuscript is rejected, the author may discuss the matter with the section editor and (or) appeal that decision to the editor-in-chief if the author(s) believe(s) that the judgment is erroneous or unfair. For appeal, a letter presenting reasons for the appeal should be sent to the editor-in-chief. A rejected manuscript may be resubmitted for publication in another section of *JAS* only if this course of action has been specifically recommended by the section editor to whom the manuscript was originally assigned and the transfer has been approved by the editor-in-chief.

The Revision Process

Almost all manuscripts that are eventually published are first returned by the section editor to the author for revision. The most common reasons for requesting revision are failure to follow *JAS Style and Form*, improper or incomplete statistical analysis, lack of clarity or brevity, questions of fact or theory, poor organization of tabular material, and grammatical errors. Under ordinary circumstances, a PDF of the revised manuscript must be returned to the section editor via *JAS Manuscript Central* within 60 d from date of receipt by the author or the author will be notified that the manuscript has been withdrawn and must be resubmitted if further consideration is desired.

Acceptance and Publication

After a paper has been accepted, every effort will be made to publish it promptly. The interval from the date when the manuscript is received to the date that it is accepted for publication by the editor-in-chief will vary depending on the time required for review and revision. The author is notified when the manuscript is accepted by the editor-in-chief. After acceptance, correspondence concerning the manuscript should be directed to the technical editor. The author will receive electronic galley proofs of articles. **ACCURACY OF THE GALLEY PROOF IS THE AUTHOR'S RESPONSIBILITY.** Failure to return the author proof approval form within 3 d may cause a delay in publication of the article.

The current publication charge is \$85 per printed page in *JAS* if at least one author is an ASAS member; when no author is a member of ASAS, the page charge is \$170. These page charges include 50 free reprints; additional reprints may be ordered. When the galley proof is sent, the author is asked to complete a reprint order form requesting the number of reprints desired and the name of the institution, agency, or individual responsible for publication charges. Authors who submit articles containing color illustrations are responsible for paying the additional charge for color printing, including the printing of any reprints they order.

Copyright Issues

The copyright to material published in *JAS* is held by ASAS. Persons who wish to reproduce material in *JAS* must request written permission from the editor-in-chief to reprint copyrighted information. Likewise, authors of *JAS* manuscripts who include material (usually tables or figures) taken from other copyrighted sources must secure permission from the copyright holders and provide written evidence of this permission at the time the manuscript is submitted to *JAS* for review. Tables or figures reproduced from the work of others must include an acknowledgment of the original source in a footnote or legend.

GUIDELINES FOR AUTHORS

Manuscripts should be typed double-spaced and with lines and pages numbered. At the time of submission, a "Manuscript Submission and Copyright Release Form" should be mailed or faxed to the Technical Editor (fax: 217-398-4119). Co-authors at different institutions can mail or fax this form independently. The form must indicate the JAS manuscript number assigned at the time of submitting the paper electronically. Accepted papers cannot be published until this form has been received. Submission of a manuscript indicates that all authors have viewed and approved the paper for release and that each author is responsible for its content. **We strongly suggest that authors use Times New Roman font with a type size of 12 points to prepare manuscripts and that all special characters (Greek, math, other alphabets) be inserted using the symbols palette available with this font. Errors in PDF generation can occur if special math fonts or other uncommon fonts are used to type the manuscript.** Type must be large enough to be read easily. Companion manuscripts or manuscripts numbered in series should be submitted at the same time and be clearly designated as companion papers. Recommended reviewers and unrecommended reviewers can be provided for consideration by the section editor.

Manuscripts submitted to *JAS* must follow these guidelines. Inadequate attention to matters of *JAS Style and Form* may result in rejection. Advice on matters not covered in the *JAS Style and Form* may be obtained from the technical editor at the ASAS business office (name, address, phone and fax numbers, and E-mail addresses are published in each issue of *JAS* and on the ASAS Web site). The primary source for the *JAS Style and Form* is *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers* (6th ed., 1994; ISBN: 0-521-47154-0). For other matters of writing style, *The Chicago Manual of Style* (14th Ed.; The University of Chicago Press, 1993; ISBN: 0-226-10389-7) is recommended. For terminology about grazing, refer to *Terminology for Grazing Lands and Grazing Animals* (The Forage and Grazing Terminology Committee, Pocahontas Press, P.O. Drawer F, Blacksburg, VA 24063-1020).

Instructions for Submitting a Manuscript Electronically

The *Journal of Animal Science* **requires** authors to submit their manuscripts electronically via our Internet site, jas.manuscriptcentral.com. Beginning **January 1, 2002**, authors will be assessed a handling fee if they submit a manuscript and disk by mail.

Electronic Submission Procedure

Using either Netscape Navigator (version 4 or higher) or Microsoft Internet Explorer (version 4 or higher),

type in <http://jas.manuscriptcentral.com> to bring up the log-in screen, or click on "Submit a Manuscript to JAS" on the JAS main page of the ASAS Web site (<http://www.asas.org/jas/>). Click on "Submission Instructions" to familiarize yourself with the procedure. Return to the log-in screen and click on either "Create an Account," if you are a first-time user, or "Check for Existing Account" if you have previously created an account. Do not create more than one account for yourself; all papers you have submitted will be available to you with a single account name and password.

Creating an Account. Clicking the "Create an Account" button will bring up the new account screen; fill in the information requested (name, address, phone and fax numbers, and E-mail address) and enter your chosen user ID, which will be necessary to access your account in the future. Be sure to make a note of your user ID.

Manuscript Submission. Log in, click on "Author Center," and then on "Submit First Draft of a New Manuscript." Note that the only file format allowable for submitted manuscripts is Adobe PDF. If you do not have the software necessary to generate a PDF yourself, you can either submit a PostScript file, which will be automatically converted to PDF by the system, or you can click on the "Create PDF of Your Manuscript" icon to make a PDF file at Adobe's Web site, using the log-in and password supplied in the online instructions. Instructions for submitting PostScript or PDF files are available from links on the log-in screen. Before creating a PDF file from your word processing document, be sure that line-numbering is turned on (numbers should be **continuous and not restart at 1 on each page**) and pages are numbered consecutively so that reviewers can refer to page and line numbers in their reviews. You will have the opportunity to view a proof of the manuscript before submitting it; please check the manuscript and all information you have filled in before submitting the paper. To view the PDF file you must have Adobe's Acrobat Reader installed on your computer (version 4 or higher); if you do not already have this free software, a link to download it is available at the bottom of the login screen, or from the main JAS Web page (www.asas.org/jas/). After you have checked for accuracy, click the "Submit" button. You will immediately be given a JAS manuscript number and an E-mail message will be sent to you and all co-authors **for whom you have supplied E-mail addresses** verifying that your manuscript has been received and entered. Make a note of your manuscript number; you and all co-authors must include this number on the mandatory "jas.manuscriptcentral.com Manuscript Submission and Copyright Release Form" that you fax or mail to the Technical Editor at ASAS Headquarters. You can keep track of the status of your paper by logging on to jas.manuscriptcentral.com, where the status will be displayed in the Corresponding Author Center, along with the name of the section editor in charge of the reviews.

If Have a Technical Problem. Assistance with technical difficulties in submission is available from ScholarOne, the parent company of Manuscript Central. Click the “Get Support Now” button and consult FAQs (frequently asked questions), accessed by clicking “Find Answers” on the main help screen. If you cannot find the answer within the FAQ list, contact ScholarOne at 804-817-2040, ext. 167 (phone) or 804-817-2020 (fax), or E-mail Support@ScholarOne.com; this contact information is also available by clicking the “Get Support Now” button.

Preparation of Manuscript

The first page of each manuscript must include the running head; title; names of authors and institutions, including the city and ZIP or postal code; and phone and fax numbers and E-mail address, if possible, of the corresponding author. The running head (an abbreviated title consisting of no more than 45 characters plus spaces) should appear at the top of page 1 of the manuscript. Capitalize only the first word and any proper nouns or abbreviations (such as chemical elements) that always require capitalization. The title of the manuscript is typed capitalizing only the first word and any proper nouns or expressions that always require capitalization. Although it should be as brief as possible, the title should include the species involved when applicable. Authors' names (use only initials for all but the last [family] name), institution, and city are listed in upper- and lowercase letters. Supplementary information, such as current addresses of authors, is given in footnotes on the first page. An address and contact information (phone; fax; E-mail) should be given in a footnote to the corresponding author's name. The footnote should begin with the word “Correspondence:” followed by a mailing address and parenthetical phone, fax, and E-mail [e.g., 1234 W. University Dr. (phone: 122-344-5555; fax: 122-44-5556; E-mail: myaddress@university.edu)]. Authors may choose not to include all this information. Indications of professorial rank or other professional titles should not be used. Acknowledgments are given as a footnote **to the title** on the first page. Footnotes on the first page and other text pages are referenced sequentially by superscript numbers. Brand names and company names and locations for all substances and equipment referred to in the text should be included in parentheses within the text, not in footnotes.

Headings

Major headings (Introduction, Materials and Methods [or Experimental Procedures], Results, Discussion [or Results and Discussion], Implications, and Literature Cited) are centered and appear in roman type, the first letter of each major word capitalized. Major headings of review papers or papers from symposia may deviate from this standard format; however, all papers

must contain an abstract, key words, an introduction, and an implications section. Abbreviations should be avoided in headings.

First subheadings appear at the left margin on a separate line in italics and are not followed by punctuation. First subheadings are used when subsections below major headings consist of several paragraphs, especially if some or all of the paragraphs begin with a second subheading.

Second subheadings appear at the beginning of the first line of a paragraph. They are indented, italicized, and followed by a period. They do not require labeling (a, b, c, etc.). Second subheadings may be used with or without first subheadings; generally second subheadings introduce brief sections below a first subheading.

Abstract

The abstract, consisting of no more than 2,500 **key-strokes** (characters plus spaces) in one paragraph, appears at the beginning of the manuscript with the word “ABSTRACT” capitalized. Hence, the abstract should summarize pertinent results in a brief but understandable form. References are never cited in the abstract. Abbreviations that appear in the abstract that are not included in the standard abbreviation listing found in each issue of *JAS* and on the ASAS Web site must be defined before they are first used. The abstract should start with a clear statement of the objective and must conclude with one or two sentences that highlight important conclusions.

Key Words

At the end of the abstract, list up to six key words that best describe the nature of the research; key words should include the species, variables tested, and the major response criteria. Key words must be selected from the most recent issues of the *CAB Thesaurus*. American spelling of words is used. The first letter of each key word is capitalized; key words are separated by commas. Key words form the basis for the subject index, which is published in the last issue of each volume of *JAS*. Because major words in the title are not used in the subject index, appropriate words from the title (or synonyms) should be listed as key words. Key words that are not included in the *CAB Thesaurus* will be changed or deleted.

Introduction

The introduction follows the abstract and must not exceed 2,000 **keystrokes** (characters plus spaces). It briefly justifies the research and specifies the hypotheses to be tested. Extensive discussion of relevant literature should be included in the discussion of results, not in the introduction. To minimize length and avoid redundancy, generally no more than three references should be cited to support a specific concept.

Materials and Methods

General. A clear description or specific original reference is required for all biological, analytical, and statistical procedures. All modifications of procedures must be explained. Diets, animals (breed, sex, age, body weight, and weighing conditions [i.e., with or without restriction of feed and(or) water]), surgical techniques, measurements, and statistical models should be described clearly and fully.

Statistics. Biology should be emphasized, but the use of incorrect or inadequate statistical methods to analyze and interpret biological data is not acceptable. Consultation with a statistician is recommended. Statistical methods commonly used in the animal sciences need not be described in detail, but adequate references should be provided. The statistical model, classes, blocks, and experimental unit must be designated. Any restrictions used in estimating parameters should be defined. Reference to a statistical package without reporting the sources of variation (classes) and other salient features of the analysis, such as covariance or orthogonal contrasts, is not sufficient. A statement of the results of statistical analysis should justify the interpretations and conclusions. When possible, results of similar experiments should be pooled statistically. Do not report a number of similar experiments separately.

The experimental unit is the smallest unit to which an individual treatment is imposed. For group-fed animals, the group of animals in the pen or the paddock is the experimental unit. If individual animals fed as a group are considered by authors to be independent experimental units, this deviation from accepted procedures must be explained and justified. Repeated chemical analyses of the same sample usually do not constitute independent experimental units. Measurements on the same experimental unit over time also are not independent and must not be considered as independent experimental units. For analysis of time effects, use time-sequence analysis.

Usual assumptions are that errors in the statistical models are normally and independently distributed with constant variance. Most standard methods are robust to deviations from these assumptions, but occasionally data transformations or other techniques are helpful. Most statistical procedures are based on the assumption that experimental units have been assigned to treatments at random. If animals are stratified by ancestry or weight or if some other initial measurement should be accounted for, the model should include a blocking factor, or the initial measurement should be included as a covariate.

A parameter (mean [μ], variance [σ^2]), which defines or describes a population, is estimated by a statistic (\bar{x} , s^2). The term *parameter* is not appropriate to describe a variable, observation, trait, characteristic, or measurement taken in an experiment.

Standard designs are adequately described by name and size (e.g., “a randomized complete block design with

six treatments in five blocks”). For a factorial set of treatments, an adequate description might be as follows: “Tryptophan at 0.05 or 0.10% of the diet and niacin at 5, 10, or 20 mg/kg of diet were used in a 2×3 factorial arrangement in five randomized complete blocks, each block consisting of littermates.” Note that a factorial arrangement is not a design; the term “design” refers to the method of grouping experimental units into homogeneous groups or blocks (i.e., the way in which the randomization is restricted).

Standard deviation refers to the variability in a sample or a population. The standard error (calculated from error variance) is the estimated sampling error of a statistic such as the sample mean. When a standard deviation or standard error is given, the number of degrees of freedom on which it rests should be specified. When any statistical value (as mean or difference of two means) is mentioned, its standard error or confidence limit should be given. The fact that differences are not “statistically significant” is no reason for omitting standard errors. They are of value when results from several experiments are combined in the future. They also are useful to the reader as measures of efficiency of experimental techniques. A value attached by “ \pm ” to a number implies that the second value is its standard error (not its standard deviation). Adequate reporting may require only 1) the number of observations, 2) arithmetic treatment means, and 3) an estimate of experimental error. The pooled standard error of the mean is the preferred estimate of experimental error. Standard errors need not be presented separately for each mean unless the means are based on different numbers of observations or the heterogeneity of the error variance is to be emphasized. Presenting individual standard errors clutters the presentation and can mislead readers.

For more complex experiments, tables of subclass means and tables of analyses of variance or covariance may be included. When the analysis of variance contains several error terms, such as in split-plot and repeated measures designs, the text should indicate clearly which mean square was used for the denominator of each F statistic. Unbalanced factorial data can present special problems. Accordingly, it is well to state how the computing was done and how the parameters were estimated. Approximations should be accompanied by cautions concerning possible biases.

Contrasts (preferably orthogonal) are used to answer specific questions for which the experiment was designed; they should form the basis for comparing treatment means. Nonorthogonal contrasts may be evaluated by Bonferroni t statistics. The exact contrasts tested should be described for the reader. Multiple-range tests are not appropriate when treatments are orthogonally arranged. Fixed-range, pairwise, multiple comparison tests should be used only to compare means of treatments that are unstructured or not related. Adjusted, or so-called least squares, means should not be used unless the design is unbalanced or contains

missing values or an adjustment is being made for a covariate. In factorial treatment arrangements, means for main effects should be presented when important interactions are not present. Means for individual treatment combinations also should be provided in table or text so that future researchers may combine data from several experiments to detect important interactions. An interaction may not be detected in a given experiment because of a limitation in the number of observations.

The terms “significant” and “highly significant” traditionally have been reserved for $P < 0.05$ and $P < 0.01$, respectively. Other probability levels can be discussed if properly qualified so that the reader is not misled, but do not report P -values to more than three decimals. When available, the exact probability levels (alpha levels) should be presented rather than merely $P < 0.05$ or $P < 0.01$ so the reader can decide what to reject. Such information is useful for future analyses in which data are combined. Regardless of the probability level used by the authors, failure to reject a hypothesis should be based on the relative consequences of type I and II errors. A “nonsignificant” relationship should not be misinterpreted; it is not evidence that no relationship exists. An inadequate number of experimental units or inadequate control of variation limits the power to detect relationships. Use of $P > 0.05$ to indicate nonsignificance should be avoided; readers may interpret this as the probability of a beta error, not an alpha error. This problem can be avoided by citing the absolute probability of an alpha error.

Give only meaningful digits. A practical rule is to round values so that the change caused by rounding is less than one-tenth of the standard error. Such rounding increases the variance of the reported value by less than 1%, so that less than 1% of the relevant information contained in the data is sacrificed. In most cases, two or three significant digits (not decimal places) are sufficient.

Results

Results (may be combined with discussion) should be presented in tabular form when feasible. The text should explain or elaborate on the tabular data, but numbers should not be repeated extensively within the text. Sufficient data, all with some index of variation attached, should be presented to allow the reader to interpret the results of the experiment.

Discussion

The discussion (may be combined with results) should interpret the results clearly and concisely in terms of biological mechanisms and should integrate literature results with the research findings to provide the reader with a broad base on which to accept or reject the hypotheses tested. Results and references to tables and figures already described in the Results section should not be repeated in the Discussion section.

Implications

This section, consisting of no more than 1,000 **key-strokes** (characters plus spaces) in one paragraph, follows the discussion and should explain in lay terms, without abbreviations, acronyms, or citations, what the findings of this research imply for animal production and(or) biology. Though some speculation is permitted, this section should also caution the reader against over-extrapolation of results. For manuscripts with direct applications, this section will consist of an interpretive summary. If results have no implications, this should be stated. This section should be directed toward readers who are not necessarily professional animal scientists. The Implications section can be accessed by any visitor to the ASAS Web site.

Appendixes

To provide readers with numerical examples or give extensive detail of analytical procedures, an appendix can be included with a manuscript. However, if the supplemental material is of interest only to a limited number of *JAS* readers, it should not be included as an appendix. Instead, mention that supplemental information is available on request from the author; addresses for Web sites with appropriate supplemental information are acceptable. In the manuscript, the appendix should follow the Literature Cited section and be introduced by a major heading.

Citations

Text. Published literature is referenced in the text in one of two ways, depending on sentence structure: 1) Increased free fatty acid concentrations have been reported after daily bovine somatotropin treatment of heifers (Eisemann et al., 1986; McShane et al., 1989) and dairy cows (Schams et al., 1991); 2) Eisemann et al. (1986) and McShane et al. (1989) have reported increased free fatty acid concentrations. . . .

When two or more citations are included in a grouping within a sentence, the citations within the grouping are arranged in chronological order. Multiple citations for a given year are further arranged alphabetically. When a citation has one or two authors, cite the reference throughout using the name(s) and the date (e.g., Galyean and Chabot, 1981). When a citation has more than two authors, cite the reference throughout the text with “et al.” following the last name of the first author (e.g., Galyean et al., 1981). When the same author(s) have two references with different dates, cite them together in the text (e.g., Huntington et al., 1988, 1990). If two papers abbreviate identically in the text, place a letter after the date in the text and in the citation in literature cited. Letters should not be included unless the text citations are identical. Lettered references should be listed in strict alphabetical order based on authors’ last names; if all names are identical, the titles of the articles dictate alphabetical order, regardless of

their page numbers or whether they are articles in a series. Check the literature cited to make certain that all text citations are represented, and that all citations listed are cited in the text. Unpublished literature is listed in the text as follows: . . . by W. A. Olson (personal communication); . . . (W. A. Olson, personal communication); . . . according to J. Noblet (unpublished data); . . . (J. Noblet, unpublished data). The individual's full name should be provided. If the unpublished data are from the authors' laboratory, it can be cited as (our unpublished observations).

References in the text to statistical or other software packages should be followed by parenthetical information giving the name of the package, if it is not included in the text, and the supplier of the software. If the software is mentioned more than once, this information need not be repeated [e.g., ". . . using the GLM procedures of SAS (SAS Inst. Inc., Cary, NC)."] In previous versions of Style and Form, this information was included in the Literature Cited section.

Literature Listing. The number of citations should be minimized by careful scrutiny; select only the most pertinent ones. Citing unrefereed publications and abstracts will not be allowed without strong justification. No more than three references should be cited to support a specific concept. Interested readers can examine those references or cited reviews for further citations. Initials are used for first and middle names in all citations. Initials are placed after the first author's name but before the last names of all coauthors.

Citations are listed in strict alphabetical order by authors' last names. If all authors are identical for two or more citations, chronological order of publication should dictate the order of citations. When more than one paper in a given year is listed by authors whose names are in the same order in each paper, the papers are arranged in alphabetical order of the paper title, and the date is assigned a letter suffix (e.g., 1983a,b). Only the first word and proper nouns in titles of papers begin with a capital letter.

When a total book is cited, page numbers are not provided. When the reference is a chapter or section from a book, give inclusive page numbers. Use inclusive page numbers for journal articles. If the pages of the journal cited are numbered within an issue rather than consecutively for a total volume, include the issue (or month), supplement, or part number in parentheses after the volume number. No comma follows the name or abbreviation of the journal cited.

References should be abbreviated in accordance with *Serial Sources for the BIOSIS Previews Database* published annually by BIOSIS, 2100 Arch Street, Philadelphia, PA 19103-1399. Periods are placed after each abbreviated word. The abbreviation "(Abstr.*)" should be used to designate each reference that is an abstract. Citations of unpublished work are listed in parentheses in the text only; they do not appear in the literature cited. Articles submitted for publication but not yet accepted cannot be cited. References from nonrefereed

publications should be avoided, but they can be used when information is not available from refereed publications. Manuscripts that have been accepted for publication but are not yet published can be listed in the literature cited with the designation "(In press)" following the journal title. Inclusive page numbers must be given in literature citations.

Please note that the examples given below differ from those in previous editions of *JAS Style and Form*. The *Journal of Animal Science*, *Journal of Dairy Science*, and *Poultry Science* now use the same reference style to facilitate manuscript preparation by authors who submit to more than one of these journals.

Books and Articles Within Edited Books

- AOAC. 1990. *Official Methods of Analysis*. 15th ed. Assoc. Offic. Anal. Chem., Arlington, VA.
- Church, D. C. 1991. *Livestock Feeds and Feeding*. 3rd ed. Prentice-Hall, Englewood Cliffs, NJ.
- Consortium. 1988. *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching*. Assoc. Headquarters, Savoy, IL.
- FASS. 1999. *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching*. 1st rev. ed. Fed. Anim. Sci. Soc., Savoy, IL.
- NPPC. 1991. *Procedures to Evaluate Market Hogs*. 3rd ed. Natl. Pork Prod. Council, Des Moines, IA.
- NRC. 1989. Pages 90-110 in *Nutrient Requirements of Dairy Cattle*. 6th rev. ed. Natl. Acad. Press, Washington, DC.
- Robinson, P. H., E. K. Okine, and J. J. Kennelly. 1992. Measurement of protein digestion in ruminants. Page 121 in *Modern Methods in Protein Nutrition and Metabolism*. S. Nissen, ed. Academic Press, San Diego, CA.
- Snedecor, G. W., and W. G. Cochran. 1989. *Statistical Methods*. 8th ed. Iowa State Univ. Press, Ames.
- Steel, R. G. D., and J. H. Torrie. 1980. *Principles and Procedures of Statistics: A Biometrical Approach*. 2nd ed. McGraw-Hill Book Co., New York.
- Varga, G. A., and H. F. Tyrell. 1989. Effect of prior rate of gain and end weight on energy metabolism, visceral organ mass and body composition of Angus \times Hereford steers. Page 287 in *Energy Metabolism of Farm Animals*. EAAP Publ. No. 43. Pudoc, Wageningen, The Netherlands.

Handbooks, Technical Bulletins, Theses, Dissertations, and Circulars

- Goering, H. K., and P. J. Van Soest. 1970. *Forage Fiber Analyses (Apparatus, Reagents, Procedures, and Some Applications)*. Agric. Handbook No. 379. ARS-USDA, Washington, DC.
- Harvey, W. R. 1977. *Users guide for LSML76, mixed model least-squares and maximum likelihood computer program*. Mimeo. The Ohio State Univ., Columbus.
- Kreikemeier, K. K. 1986. *Improving grain utilization in ruminant diets*. M.S. Thesis, Univ. Nebraska, Lincoln.
- Sigma. 1984. *Total hemoglobin: Quantitative, colorimetric determination in whole blood at 530-550 nm*. Tech. Bull. No. 525. rev. ed. Sigma Chemical, St. Louis, MO.
- Ward, J. D. 1995. *Effects of copper deficiency on performance and immune function of cattle*. Ph.D. Diss., North Carolina State Univ., Raleigh.

Journal Articles

- Broderick, G. A., and J. H. Kang. 1980. Automated simultaneous determination of ammonia and total amino acids in ruminal fluid and in vitro media. *J. Dairy Sci.* 63:64–75.
- Cleale, R. M., IV, R. A. Britton, T. J. Klopfenstein, M. L. Bauer, D. L. Harmon, and L. D. Satterlee. 1987a. Induced non-enzymatic browning of soybean meal. II. Ruminal escape and net portal absorption of soybean protein treated with xylose. *J. Anim. Sci.* 65:1319–1326.
- Cleale, R. M., IV, T. J. Klopfenstein, R. A. Britton, L. D. Satterlee, and S. L. Lowry. 1987b. Induced non-enzymatic browning of soybean meal. I. Effects of factors controlling non-enzymatic browning on in vitro ammonia release. *J. Anim. Sci.* 65:1312–1318.
- Guthrie, H. D., V. G. Pursel, and L. T. Frobish. 1976. Attempts to initiate conception in lactating sows. *J. Anim. Sci.* 43:287. (Abstr.)
- Hall, J. B., R. B. Staigmiller, R. E. Short, R. A. Bellows, S. E. Bartlett, and D. A. Phelps. 1993. Body composition at puberty in beef heifers as influenced by nutrition and breed. *J. Anim. Sci.* 71(Suppl. 1):205. (Abstr.)

Conference Proceedings and Unpublished Presentations

- Barbano, D. M. 1996. Mozzarella cheese yield: Factors to consider. Page 29 in Proc. Wisconsin Cheese Makers Mtg., Ctr. Dairy Res., Univ. Wisconsin, Madison.
- Henderson, C. R. 1973. Sire evaluation and genetic trends. Pages 10–41 in Proc. Anim. Breeding Genet. Symp. in Honor of Dr. J. L. Lush, Am. Soc. Anim. Sci., Am. Dairy Sci. Assoc., Champaign, IL.
- Marchello, M. J. 1996. Nutrient composition of fed bison. Paper presented at Natl. Bison Assoc. annu. conf., Roanoke, VA.
- NMC. 1995. Summary of peer-reviewed publications on efficacy of premilking and postmilking teat disinfections published since 1980. Pages 82–92 in Natl. Mastitis Council. Reg. Mtg. Proc., Harrisburg, PA. Natl. Mastitis Council, Arlington, VA.
- Talmant, A., X. Fernandez, P. Sellier, and G. Monin. 1989. Glycolytic potential in longissimus dorsi muscle of Large White pigs as measured after in vivo sampling. Page 1129 in Proc. 35th Int. Cong. Meat Sci. Technol., Copenhagen, Denmark.
- Van der Werf, J. H. J. 1990. A note on the use of conditional models to estimate additive genetic variance in selected populations. Proc. 4th World Cong. Genet. Appl. Livest. Prod., Edinburgh, Scotland XIII:476–479.

Electronic Publications

- FDA. 2001. Effect of the use of antimicrobials in food-producing animals on pathogen load: Systematic review of the published literature. Available: <http://www.fda.gov/cvm/antimicrobial/PathRpt.PDF>. Accessed Dec. 14, 2001.
- Le Neindre, P., C. Terlouw, X. Boivin, A. Boissy, and J. Lensink. 2001. Behavioral research and its application to livestock transport and policy: A European perspective. *J. Anim. Sci.* 79(E-Suppl.) Online. Available: <http://www.asas.org/jas/jas0905.pdf>. Accessed Oct. 7, 2001.
- McGuire, M. A., and M. K. McGuire. 2000. Conjugated linoleic acid (CLA): A ruminant fatty acid with beneficial effects on human health. Proc. Am. Soc. Anim. Sci., 1999. Available: <http://www.asas.org/jas/symposia/proceedings/0938.pdf>. Accessed Dec. 15, 2000.

Abbreviations of Frequently Cited Periodicals

Acta Agric. Scand.

Acta Endocrinol.
 Adv. Appl. Microbiol.
 Adv. Carbohydr. Chem. Biochem.
 Adv. Genet.
 Adv. Lipid Res.
 Adv. Protein Chem.
 Agric. Eng.
 Agron. J.
 Am. J. Anat.
 Am. J. Clin. Nutr.
 Am. J. Clin. Pathol.
 Am. J. Hum. Genet.
 Am. J. Obstet. Gynecol.
 Am. J. Pathol.
 Am. J. Physiol.
 Am. J. Vet. Res.
 Anal. Biochem.
 Anal. Chem.
 Anim. Behav.
 Anim. Breed. Abstr.
 Anim. Feed Sci. Technol.
 Anim. Prod.
 Ann. Hum. Genet.
 Annu. Rev. Biochem.
 Annu. Rev. Pharmacol. Toxicol.
 Annu. Rev. Physiol.
 Antibiot. Chemother. (Basel)
 Antibiot. Chemother. (Washington, DC)
 Appl. Environ. Microbiol.
 Appl. Microbiol.
 Arch. Biochem. Biophys.
 Aust. J. Agric. Res.
 Aust. J. Exp. Agric.
 Biochem. J.
 Biochemistry
 Biochim. Biophys. Acta
 Biol. Reprod.
 Biometrics
 Biometrika
 Blood
 Br. J. Nutr.
 Br. Vet. J.
 Can. J. Anim. Sci.
 Can. J. Res. Sect. D Zool. Sci.
 Cell
 Cereal Chem.
 Clin. Toxicol.
 Comp. Biochem. Physiol.
 Domest. Anim. Endocrinol.
 Endocrinology
 Eur. Assoc. Anim. Prod. Publ.
 Fed. Proc.
 Feedstuffs
 Fertil. Steril.
 Food Res.
 Food Technol.
 Gastroenterology
 Genetics
 Grass Forage Sci.

Growth
 Gut
 Horm. Behav.
 Immunology
 Infect. Immun.
 Ir. J. Agric. Res.
 J. Agric. Food Chem.
 J. Agric. Sci.
 J. Am. Oil Chem. Soc.
 J. Am. Vet. Med. Assoc.
 J. Anim. Physiol. Anim. Nutr.
 J. Anim. Sci.
 J. Assoc. Off. Anal. Chem.
 J. Clin. Endocrinol. & Metab.
 J. Dairy Sci.
 J. Food Compos. Anal.
 J. Gen. Physiol.
 J. Hered.
 J. Nutr.
 J. Nutr. Biochem.
 J. Physiol. (Lond.)
 J. Physiol. (Paris)
 J. Range Manage.
 J. Reprod. Fertil.
 J. Sci. Food Agric.
 Journ. Rech. Porcine Fr.
 Lab. Anim.
 Lipids
 Livest. Prod. Sci.
 Meat Sci.
 Metabolism
 Methods Enzymol.
 Mol. Cell. Endocrinol.
 N. Engl. J. Med.
 N. Z. J. Agric. Res.
 Nature (Lond.)
 Nature (Paris)
 Neth. J. Agric. Res.
 Neuroendocrinology
 Nutr. Abstr. Rev.
 Nutr. Metab.
 Nutr. Rep. Int.
 Nutr. Res.
 Obstet. Gynecol.
 Pharmacol. Rev.
 Physiol. Rev.
 Pig News Info.
 Poult. Sci.
 Proc. N. Z. Grassl. Assoc.
 Proc. Nutr. Soc.
 Proc. R. Soc. Lond. B Biol. Sci.
 Proc. Soc. Exp. Biol. Med.
 Prof. Anim. Sci.
 Q. J. Exp. Physiol.
 Recent Prog. Horm. Res.
 Reprod. Fertil. Dev.
 Residue Rev.
 S. Afr. J. Anim. Sci.
 Sci. Agric.

Science (Wash DC)
 Steroids
 Theor. Appl. Genet.
 Theriogenology
 Toxicol. Appl. Pharmacol.
 Trans. Am. Soc. Agric. Eng.
 Vet. Rec.
 Vet. Res. Commun.
 Vitam. Horm.
 World Anim. Rev.
 Z. Tierz. Zuechtungsbiol.
 Zentralbl. Veterinaermed. Reihe

Tables

Refer to a recent issue of *JAS* for examples of table construction. When possible, tables should be organized to fit across the page (similar to the text), so that the page can be read without turning it sideways. Tables are numbered consecutively in Arabic numbers; each table begins on a separate page. All parts of tables should be typed double-spaced. Tables should be inserted in the manuscript after the literature cited section. Diet tables need not list the International Feed Number for feedstuffs, but tables should specify whether composition and analyses are provided on an “as-fed” or a “dry matter” percentage basis.

Titles of tables should be descriptive enough to be able to stand alone. With the exception of proper nouns or parenthetical, abbreviated units of measure or acronyms that are ordinarily capitalized, only the first letter of “Table” and the initial letter of the title should be capitalized. No period follows the table title. Every column must have a heading (e.g., Ingredient, Trait, Fatty acid, Item). Side-type titles, providing rows as column headings, can be used. Only the first letter of the first word of each column heading is capitalized. The abbreviations for “weight” and “average” (wt and avg, respectively) should be used only in tables.

Present data in a simple, straightforward manner. Do not present the same data in tabular and graphic form. When presenting data in graphic form, be sure that each mean and some index of variation is provided in the figures, the figure legend, or the text. Avoid graphs presenting less than five means. Present such values in the text. If data are discussed in the text but are not included in the tables or figures, specify “(data not shown)” in the text.

Include a zero to the left of the decimal point. Use only meaningful digits. If there is no datum for a particular entry, insert a dash. If an explanation is necessary, use an abbreviation in the body of the table (e.g., ND) and explain clearly in footnotes what ND stands for (not determined, not detectable, not discernible, etc.).

References to footnotes in a table are specified by superscript lowercase letters independently for each table. The final letters of the alphabet may be used to designate significance of differences to avoid overlap with other footnotes. The preferred order of super-

scripts is as follows: 1) title, 2) column headings, 3) row headings, and 4) body of table. The dagger symbol (†) and asterisks (*, **, ***) are used only to designate a significance level between two means in a given row or column. By convention, these are understood to imply the following: † designates $P < 0.10$; * designates $P < 0.05$; ** designates $P < 0.01$, and *** designates $P < 0.001$. Do not use vertical lines in tables.

Presentation of pooled standard errors, the general basis for statistical comparison of means, is recommended when variance is homogeneous. These are provided in a separate column or row. Standard errors can be attached to each mean by \pm signs when variance or SE are heterogeneous (e.g., unbalanced experiments or unequal numbers of observations in treatment means). When variances are heterogeneous and are mathematically transformed before statistical analysis, specify the transformation method by a tabular footnote but back-transform the data before presenting them in tables. When means separation procedures are used, the preferred statement in the footnotes is “Within a row (or column), means without a common superscript letter differ ($P < 0.05$)”; other P -values may be specified. Alternative wording may be misinterpreted or erroneous. Specifying treatments in the statistics footnote can simplify comprehension.

Figures

Figures should be prepared with bold lines and should reproduce clearly when reduced to fit in either one or two columns. Scale of lettering and intensity of lines should remain readable when reduced in size for publication. When preparing figures, use clearly defined symbols and the following types of lines: — —, ····, - · - · - · - ·, - - - -. Be sure that the reader will be able to distinguish which line is which. In the case of bar graphs, maximize the contrast between fillers. For example, shaded fillers and close-lined or -checked fillers will all appear shaded when a figure is reduced for publication. Symbols and abbreviations used in the figure must be defined in the figure legend or within the figure itself. All lettering and abbreviations must conform to the *JAS Style and Form*. Units in axes should not be placed in parentheses; when units follow a term or phrase they should be preceded by a comma.

Photomicrographs must have their unmagnified size designated (e.g., 5 μm). This can be either within the photo or, alternatively, the original width of the total unmagnified field can be designated in the figure legend. Reduction for publication can make a magnification power designation for photomicrographs (e.g., 1,000 \times) inappropriate. Do not submit photographs that have been rendered in a dot pattern (screened).

Figures in PDF files submitted to JAS Manuscript Central for review should be positioned following the tables, or the Literature Cited section if there are no tables. Figure legends should appear below the respective figures to which they refer. The best formats for

figure files are Tagged Image File Format (TIFF) for graphs and JPEG for photographs. In most cases 150 dpi for TIFF and JPEG images should be sufficient resolutions. Figures should be high enough resolution to be legible when printed. Restrict figure dimensions to the smallest size that can be easily read. The use of color in figures should be avoided unless color is absolutely essential to understanding the figure.

Miscellaneous Usage Notes

1. Use only the metric system (Système International d’Unités). When a term must be expressed in non-metric (e.g., avoirdupois) units for clarity (e.g., bushel weight), give such values in parentheses after the metric value. Various unit converters are available on the Internet.
2. The words “Table” and “Figure” are capitalized, and not abbreviated, in the text when referring to a specific table or figure. Use Arabic numerals, not Roman numerals, to designate tables, figures, experiments, groups, etc. The word “experiment” should be capitalized and abbreviated (Exp.) preceding a numeral, except in headings or manuscript titles or at the beginning of a sentence.
3. Avoid redundancy in giving the statistical significance of differences (i.e., do not use some form of the word “significance” together with a probability statement). For example, write “Stearic acid concentration was greater ($P < 0.05$) in loin drippings than in ham drippings” instead of “Stearic acid concentration was significantly ($P < 0.05$) greater in loin drippings than in ham drippings.”
4. Calculations of efficiency should usually be expressed as output divided by input (e.g., gain/feed, not feed/gain). This avoids the spurious positive and negative infinity values when gain is zero or negative. It also avoids the confusion and wording problems associated with discussing an improvement as being a decrease. However, because gain/feed varies with rate of gain, the slope of a regression (added gain/unit of added feed) can be provided in addition to gain/feed. To avoid decimals, gain/feed can be expressed as gain (g)/feed (kg).
5. Numerals
 - a) Never begin a sentence with numerals. Supply another word or spell out the number, along with any unit of measure that follows it.
 - b) Units of measure immediately preceding or following a numerical value must be abbreviated (e.g., 7 kg, d 32), unless they begin a sentence. Note that numbers and units that function as adjectives (e.g., 7-kg pigs, d-32 mea-

- surements, 100-mL flask) are treated like any other hyphenated adjective. If a word intervenes between the numeral and its unit, the unit is spelled out, not abbreviated (e.g., 14 consecutive hours; three consecutive days).
- c) Include a leading zero in all values less than 1 that are preceded by a decimal point (e.g., 0.7, rather than .7).
 - d) Use words for numbers one through nine when they precede nouns other than units of measure but use numerals for numbers larger than nine (e.g., four animals, two times, 14 lots, 28 pigs). When a series includes numbers both above and below 10, use numerals for all.
 - e) Ordinal numbers up to ninth should be spelled out in the text; they may be abbreviated in tables. Abbreviate higher ordinal numbers (e.g., 12th, 32nd).
 - f) The terms “twofold” up to “ninefold” are written as one word. Use numerals for 10 and higher (e.g., 10-fold, 300-fold) as well as for all decimal numerals (e.g., 8.5-fold). Exercise care when using “-fold” to designate a response. To avoid misleading interpretations, use the suffix *-fold* only to indicate multiplication by some number (e.g., a fivefold increase indicates a base number multiplied by five). Note that -fold, if used, can only be used to indicate an increase, never a decrease.
 - g) Avoid the use of multiplying factors (e.g., $\times 10^6$; $\times 10^{-6}$) in table columns or rows because of uncertainty whether the data are to be, or have already been, multiplied by these factors. Avoid ambiguity by stating units (e.g., numbers of spermatozoa, millions/mL).
 - h) Do not use a slant line for “per” when more than a single slant line occurs in the expression (e.g., use 5 mg/(g·d) or 5 mg·g⁻¹·d⁻¹ instead of 5 mg/g/d, but g/d is acceptable). Mathematically, “per” usually implies division. When two “per” occur consecutively, it is unclear precisely what is being divided by what.
 - i) Do not use a hyphen to indicate inclusiveness (e.g., use 12 to 14 mg or wk 3 and 4, not 12–14 mg or wk 3–4).
 - j) Report time on the 24-h system and omit the h (e.g., 1410 rather than 2:10 p.m. or 1410 h).
 - k) Use commas in all numerals in text and in tables for values with four or more digits except for numerals designating time of day.
 - l) Convert “mg %” to other units, such as mg/L or mg/mL; use “mol/100 mol” rather than “molar percent.”
 - m) When tabulating values for growth or intake, express values for a standard time period for a single animal such as weight gain per day, not weight gain per period or weight gain per pen; use mean feed intake/day, not feed intake/(pen·day).
6. Leave spaces around all mathematical operation signs in text and in equations (e.g., $n = 8$, $P < 0.05$, $a + b$). For negative numbers, leave no space between the negative sign and the number.
 7. Use chemical symbols for elements if they appear more than once in the manuscript. Formulas for simple compounds (e.g., NaCl, HNO₃, NH₄OH) are acceptable.
 8. Trademarked or registered names should be capitalized, but no TM or ® symbol is necessary.
 9. Mass number precedes chemical symbols (e.g., ¹⁴C or ¹³¹I), unless spelled out (e.g., carbon-14, iodine-131). In an isotopically labeled compound, the isotope prefix in brackets precedes and is attached directly to the part of the name to which it refers (e.g., sodium [¹⁴C]formate, [³H]estradiol).
 10. Use generic terms and names where possible. Include in parentheses within the text the brand name, the company name, and the company location for all substances and equipment mentioned.
 11. Use italics to designate genus and species (*Bos taurus*) and botanical varieties (*Medicago sativa* var. Potomac). Designations for botanical cultivars should be either preceded by cv. or enclosed in single quotation marks. (*Festuca arundinacea* cv. Kentucky 31 OR *Festuca arundinacea* ‘Kentucky 31’). When an epithet is transferred from its original position or changed in rank the original author’s name is placed in parentheses followed by the name(s) of the author(s) responsible for the change (*Cynodon dactylon* (L.) Pers.).
 12. When measurements are transformed from word terms into numeric form for statistical analysis (e.g., Good +; Slightly Abundant; Moderately Tender), present the numeric means, not the word means, in all tables or figures. Specify by a footnote or in the legend the word term for two points within the range of numeric values (e.g., 400 = Good and 467 = Good +).

13. Cite centrifugal force in units of *g*, not as rpm.
14. A diet is a feedstuff or a mixture of feedstuffs; a ration is the daily allotment of the diet.
15. Avoid jargon unfamiliar to scientists from other disciplines. Do not use the term “head” to refer to an animal or group of animals. Instead, use animal, sow, ewe, mare, steer, heifer, cattle, etc.
16. Avoid bi- as a prefix because of its ambiguity. The term biweekly means twice per week *and* once every 2 wk.
17. Dietary energy may be expressed either in calories or in joules; the standard SI unit for energy in joules.

Bq	becquerel
°C	degree Celsius
cal	calorie
Ci	curie
cM	centimorgan (spell out morgan if used without a prefix)
Da	dalton
dpm	disintegrations/minute
Eq	equivalent
g	gram
ha	hectare
Hz	hertz
IU	international unit
J	joule
kb	kilobase(s)
L	liter
lx	lux
m	meter
M	molar (concentration; preferred over mol/L)
mol	mole
N	normal (concentration)
Pa	pascal
ppb	parts/billion parts
ppm	parts/million parts
ppt	parts/trillion parts
t	metric ton (1,000 kg)
V	volt
W	watt

Word Abbreviations

The use of author-defined abbreviations and acronyms, especially for treatments, is strongly discouraged. Unless included in the list of abbreviations in each *JAS* issue or in these guidelines, each author-coined abbreviation must be defined the first time it is used in the abstract and again in the body of the manuscript. There is no need to define symbols for elements or simple compounds. Abbreviations in the titles of papers and tables and in text headings should be avoided. Do not begin a sentence with an abbreviation, acronym, or symbol. Use of abbreviations and acronyms in the abstract should be limited.

Abbreviate units of measure immediately adjacent to numerals. Units of measure are not abbreviated when they follow a spelled-out number at the beginning of a sentence. All abbreviations are written as singular even though they may be plural (e.g., yr, not yrs; VFA, not VFAs); number is indicated by verb choice.

The term *United States* may be abbreviated as U.S. when used as an adjective, but it should be spelled out when used as a noun. Abbreviations such as “i.e.,” and “e.g.,” are parenthetical and require commas.

List of Abbreviations

The following is a partial list of acceptable abbreviations. For a more extensive list, refer to *Scientific Style and Format*. Use of three-letter abbreviations for amino acids (e.g., Ala) is acceptable in *JAS*. For chemical units and abbreviations, refer to *The ACS Style Guide* (published by the American Chemical Society, Washington, DC). Anatomical nomenclature is described in the current *Nomina Anatomica Veterinaria*.

Physical units

Item	Unit
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Units of time

Item	Unit
s	second
min	minute
h	hour
d	day
wk	week
mo	month
yr	year

Statistical symbols and abbreviations^a

Item	Term
ANOVA	analysis of variance
CV	coefficient of variation
df	degree(s) of freedom
<i>F</i>	<i>F</i> -distribution (variance ratio)
LSD	least significant difference
<i>n</i>	sample size (used parenthetically or in footnotes)
<i>P</i>	probability
<i>r</i>	simple correlation coefficient
<i>r</i> ²	simple coefficient of determination
<i>R</i>	multiple correlation coefficient

R^2	multiple coefficient of determination
s^2	variance (sample)
SD	standard deviation (sample)
SE	standard error
SEM	standard error of the mean
t	t - (or Student) distribution
\bar{x}	mean (sample)
α	probability of Type I error
β	probability of Type II error
μ	mean (population)
σ	standard deviation (population)
σ^2	variance (population)
χ^2	chi-squared distribution

^aThe symbols †, *, **, and *** are normally used to show significance at the $P = 0.10, 0.05, 0.01,$ and 0.001 levels, respectively. Significance at other levels should be specifically designated.

Others

Item	Term
AA	amino acid(s)
ACTH	adrenocorticotrophic hormone
ADF	acid detergent fiber (assumed sequential unless designated otherwise)
ADFI	average daily feed intake (not to be confused with DMI)
ADG	average daily gain
ADIN	acid detergent insoluble nitrogen
ADL	acid detergent lignin
ADP	adenosine diphosphate
AI	artificial insemination
AIA	acid insoluble ash
ARS	Agricultural Research Service
Assoc.	Association
ATP	adenosine triphosphate
avg	average (use only in tables, not in the text)
BLUP	best linear unbiased prediction
bp	base pair
BSA	bovine serum albumin
Bull.	Bulletin
BW	body weight (not after feed deprivation unless designated otherwise)
Circ.	Circular
cfu	colony-forming unit
CoA	coenzyme A
Co-EDTA	cobalt ethylenediaminetetraacetate
Coll.	College
Conf.	Conference
Cong.	Congress
CP	crude protein ($N \times 6.25$)
D	dextro-
DE	digestible energy
DEAE	(dimethylamino)ethyl (as in DEAE-cellulose)
DFD	dark, firm, and dry (meat)
DM	dry matter

DMI	dry matter intake
DNA	deoxyribonucleic acid
EBV	estimated breeding value
eCG	equine chorionic gonadotropin
ed.	edition, editor(s)
EDTA	ethylenediaminetetraacetic acid
EFA	essential fatty acid
e.g.,	for example
EIA	enzymeimmunoassay
ELISA	enzyme-linked immunosorbent assay
EPD	expected progeny difference
Eq.	Equation(s)
et al.	et alia
etc.	et cetera
Exp.	experiment (always followed by a numeral)
Ext.	extension
FFA	free fatty acid(s)
FSH	follicle-stimulating hormone
g	gravity
GE	gross energy
GLC	gas-liquid chromatography
GLM	general linear model
GnRH	gonadotropin-releasing hormone
GH	growth hormone
GHRH	growth hormone-releasing hormone
hCG	human chorionic gonadotropin
HEPES	N -(2-hydroxyethyl)piperazine- N' -2-ethanesulfonic acid
HPLC	high performance (pressure) liquid chromatography
i.d.	inside diameter
i.e.	that is
IGF	insulin-like growth factor
IGFBP	insulin-like growth factor-binding protein(s)
i.m.	intramuscular(ly)
Inst.	institute
i.p.	intraperitoneal(ly)
i.v.	intravenous(ly)
IVDMD	in vitro dry matter disappearance
L	levo-
LD ₅₀	lethal dose 50%
LH	luteinizing hormone
LHRH	luteinizing hormone-releasing hormone
ME	metabolizable energy
Misc.	miscellaneous
Monogr.	monograph
NAD	nicotinamide adenine dinucleotide
NADH	reduced form of NAD
Natl.	national
NDF	neutral detergent fiber
NE	net energy
NE _g	net energy for gain
NE _l	net energy for lactation
NE _m	net energy for maintenance
NEFA	nonesterified fatty acid
No.	number (use only in tables, not in the

	text)	SSC	saline-sodium citrate buffer
o.d.	outside diameter	SSPE	saline-sodium phosphate-EDTA buffer
OM	organic matter	Stn.	station
PAGE	polyacrylamide gel electrophoresis	Suppl.	supplement
PBS	phosphate-buffered saline	Symp.	symposium
PCR	polymerase chain reaction	TDN	total digestible nutrients
PG	prostaglandin	Tech.	technical
PMSG	pregnant mare's serum gonadotropin	TLC	thin layer chromatography
PSE	pale, soft, and exudative (meat)	Tris	tris(hydroxymethyl)aminomethane
Publ.	publication	univ.	university
PUFA	polyunsaturated fatty acid(s)	USDA	U.S. Department of Agriculture
QTL	quantitative trait locus (loci)	UV	ultraviolet
Rep.	Report	VFA	volatile fatty acid
RFLP	restriction fragment length polymorphism	vol	volume
RIA	radioimmunoassay	vol/vol	volume/volume (used only in parentheses)
RNA	ribonucleic acid	vs	versus
rpm	revolutions/minute (not to be used to indicate centrifugal force)	wt	weight (use only in tables, not in the text)
s.c.	subcutaneous(ly)	wt/vol	weight/volume (used only in parentheses)
SDS	sodium dodecyl sulfate	wt/wt	weight/weight (used only in parentheses)
ST	somatotropin	×	multiplied by or crossed with
sp., spp.	one species, several species		
