Abstract

Bibliometric techniques were used in the analyses to provide comparative information on the citation characteristics of theses and dissertations and research faculty publications in food science over an eleven-year period. Thirty dissertations, 100 theses, and 1,000 faculty publications were analyzed in this study. The theses and dissertations contain 22,212 cited references, and the 1,000 faculty publications contain 40,006 cited references for a total of 62,218 references that were used. The results show that the average number of cited references was greater for the dissertations than the theses, and both were higher than the average for faculty publications. The results demonstrate the types of publications that they cite; the age of resources; the characteristics of the journals they cite (scatter of cited journals articles, zones of cited journals, overlap of cited journals, Journal Citation Report categories and ranking of cited journals); and the publishers of cited journals. The similarities and differences between graduate students’ citation patterns (theses and dissertations) and those of the faculty are highlighted and discussed throughout the paper.

Introduction

Making collection management decisions concerning resources in academic libraries is important and challenging. This is due to the mission of libraries to meet the needs of a wide range of users, the high cost of subscription to journals and databases, and the escalating annual price increases imposed by publishers. These often occur in circumstances where the operating
collection budgets are flat. Given these factors, librarians are well-advised to undertake regular evaluations of the cost-effectiveness of their subscribed resources in order to provide the best resources to meet their patrons’ needs within limited budgets. These assessments may include citation studies, cost analysis, usage surveys, and the use of COUNTER data (Suseela, 2011). COUNTER reports supplied by database and journal vendors provide product usage data in a consistent way across subscription electronic resources. These data enable the calculation of cost per use based on views, downloads, etc. and can provide some information on usage of a resource for quick comparison and identification of journal use. COUNTER reports do not actually show if and/or why the resource was used, as browsing and downloads do not always translate into the resource being used or cited. Also, the reports do not indicate the type of library patron using the resource (Davis, 2004; Suseela, 2011).

By identifying the sources that graduate students cite in their doctoral dissertations and masters theses and the sources that the faculty cite in their papers, librarians may have a good idea of the resources that are actually being used by a group of patrons within a specific discipline. The data gathered from studies like these for specific disciplines, though tedious, would complement the data supplied by publishers for specific journals and provide greater insights into the resources used by our clientele.

**Previous Studies**

There are citation studies for many science and technology disciplines that have used dissertations and/or theses as the source of their analyses, including: animal science (Olatokun & Makinde, 2009; Salami & Olatokun, 2017); agriculture, forestry, and veterinary medicine (Dulle et al., 2004); agriculture and biology (Kayongo & Helm, 2012; Kuruppu & Moore, 2008); aerospace engineering, astronomy, biochemistry, electrical engineering, geology, mechanical
engineering, and physics (Conkling et al., 2010); engineering (aerospace, electrical, and mechanical) and science (astronomy, biochemistry, geology, and physics) (Becker & Chiware, 2015); chemistry (Gooden, 2001); physics and chemistry (Kumbar & Hadagali, 2009); and physics (Sudhier Pillai, 2007).

To identify if there were differences between faculty and doctoral students’ citation characteristics at Quebec Universities between 2000 and 2007, Larivière et al. (2013) compared their referencing behavior of 5,627 first-authored papers by doctoral students and 6,372 first-authored papers from faculty. These papers were gathered from the Web of Science database. They identified significant differences between the two groups’ referencing behavior regarding number of references, age of publications, types of scholarly genre cited, and self-citation practices of faculty members and doctoral students.

McCain and Bobick (1981) analyzed faculty publications, doctoral dissertations, and preliminary doctoral qualifying briefs produced by faculty and students of the Biology Department at Temple University, and assessed journal use in the Biology Library during the years 1975-1977. Utilizing 3,739 citations to 336 journals, they examined the distribution of citations among journal titles in each of the three source groups and the combined sources ranking. Their study indicated that “citation analysis can provide useful information in assessing actual and potential journal use, independent of library holdings, in a departmental library which serves a heterogeneous clientele. The citation patterns illustrate the similarities, differences, and interrelationships among the Biology faculty, doctoral, and second-year graduate students” (McCain & Bobick, 1981, p. 266). They also found that the three user groups cited a common set of journals and specific subject fields.
Using Kendall’s rank correlation coefficient to test the degree of correlation between the journals most cited by the graduate students and faculty in four studies in geology and biology, Zipp (1996) found positive correlation in three datasets. McCullough (2016) studied the journal usage in the Department of Polymer Science at Akron University in faculty-supervised dissertations and faculty publications. Using Kendall’s rank-correlation coefficient, this study also found the correlations between journal usage in faculty publications and faculty-supervised dissertations were much stronger at the research group level (i.e., faculty and their supervised dissertations) than at the departmental level. These results are expected, as graduate students and faculty normally work in the same area of research and use the same resources.

Two previously published citation studies (Salisbury et al., 2007; Salisbury et al., 2020) relating to food science and technology utilized only faculty research as the basis of their analyses. Salisbury et al. (2020) updated the 2007 study and utilized the faculty publications to identify: (1) their publishing patterns and the types of material they are publishing; (2) a core set of journals and other resources which they are publishing in and citing over this period; (3) the characteristics of the journals in which they publish and cite (i.e., scatter of publications, Bradford distribution, major publishers, ranking and subject categories based on the Journal Citation Reports (JCR)); cooperation and productivity of the authors based on Lokta’s law; (4) the degree of openness of their publications and their citation advantage, if any; and (5) the age of resources that are referenced. There is an absence of comparative studies that analyzed the nature and characteristics of the citations in graduate students’ dissertations and theses in this area. This study and its findings are intended to fill this gap.
Objectives of the Study

This study provides comparative information on the citation characteristics of the theses and dissertations and research faculty publications from one university department, the Department of Food Science at the University of Arkansas, over an eleven-year period (2008-2018). The objectives of the research are to identify: (a) types of publications cited; (b) the age of resources referenced; (c) a core set of journals cited over this time period; (d) the characteristics of the journals cited (scatter of cited journal articles, tiers of cited journals, overlap of cited journals, Journal Citation Report categories, and ranking of cited journals); and (e) publishers of cited journals. The similarities and differences in citation patterns between graduate students’ theses and dissertations and publications of the faculty are highlighted and discussed throughout.

Methodology

The references from the dissertations and theses were extracted. The elements of these references were parsed, separated into fields and stored in an Excel spreadsheet. These were sorted and examined for completeness; those missing information were updated. All references were classified by material type and the source titles identified.

To identify the faculty research publications, searches were conducted in the Web of Science Core Collection, Food Science and Technology Abstracts (FSTA), and CAB Abstracts. Because of the comprehensive indexing of food science literature in these three databases, we assumed that the items retrieved from these three sources provided most of their research publications for this period, although it may not be all. These publications were exported into RefWorks, duplicates were removed, and then exported in a tab-delimited format for further processing using Excel.
The cited references were included in the records exported from the Web of Science Core Collection; these were exported to the RefWorks database. However, cited references are not available in FSTA, CAB Abstracts, so for records identified in these databases, their cited references were gathered manually from the individual documents in a similar manner for the theses and dissertations. These cited records were used for this study and analyzed by several parameters similar to those identified in the objectives above (Salisbury et al., 2020).
Results and Discussion

Dissertations, Theses, and Faculty Research Publications

Table 1 shows the number of theses, dissertations, and faculty publications by year and the average number of references in these. From 2008 to 2018, 30 dissertations, 100 theses, and 1,000 faculty publications were identified for the study. The theses and dissertations contain 22,212 cited references, and the 1,000 faculty publications contain 40,006 cited references for a total of 62,218 references that were used in this analysis. The results show that the average number of cited references was greater for the dissertations than the theses, and both were higher than the average for faculty publications. The average number of cited references for all the dissertations were 249, for the theses 147, and for faculty publications 40. This result is not surprising since theses and dissertations generally have several chapters and are longer than journal articles.

<table>
<thead>
<tr>
<th>Year</th>
<th>All Pubs</th>
<th>All Refs</th>
<th>Graduate Pubs</th>
<th>Graduate Refs</th>
<th>Ph.D. Pubs</th>
<th>Ph.D. Refs</th>
<th>M.S. Pubs</th>
<th>M.S. Refs</th>
<th>Faculty Pubs</th>
<th>Faculty Refs</th>
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</thead>
<tbody>
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</tr>
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<td>30</td>
<td>7469</td>
<td>100</td>
<td>14743</td>
<td>1000</td>
<td>40006</td>
</tr>
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</table>
Characteristics of their cited publications

Types of publications

Table 2 lists the types of publication that were cited by the three groups. All three groups overwhelmingly cited journal articles. Overall, 85.4% of all references were to journal articles: 87.3% in the faculty publications, 82.6% in the dissertations, and 81.9% in the theses. For faculty publications, the ratio of cited journal articles to other publications (excluding the uncategorized) is 8.32:1, for dissertations 5.15:1, for theses 4.91:1, and for all three groups is 6.77:1.

Dissertations and theses cite a higher percentage of books than the faculty. The ratio of journal articles to books/monographic series cited for faculty is 15.00:1, versus 9.60:1 for dissertations, 9.70:1 for theses, and 12.61:1 for all three groups. On average, the faculty cited less government related documents and web resources than the dissertations and theses. Though not specific to food science, other studies indicated that the cited references were predominately based on the use of the periodical literature in the sciences (McCain & Bobick, 1981; Schmidt et al., 1994; Zipp, 1996).

<table>
<thead>
<tr>
<th>Type</th>
<th>All</th>
<th>Graduate</th>
<th>Ph.D.</th>
<th>M.S.</th>
<th>Faculty</th>
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<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
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<td>Magazine / Newspaper / Newsletter</td>
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<td>100%</td>
<td>22212</td>
<td>35.7%</td>
<td>7469</td>
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</tbody>
</table>
**Age of cited references**

Knowing the age of citations that researchers use in their publications will enable collection librarians to make evidenced-based decisions when deciding on the appropriate resources to support their researchers. This may include the selection of appropriate backfiles of journals to add to their collections, in addition to providing secondary sources and book resources with the appropriate years of coverage. Overall, 83.12% of all the citations were less than 20 years old, and only 3.58% of these were older than 40 years. The average age of citation for all documents is 12.33 years (Table 3, and Fig. 1).

<table>
<thead>
<tr>
<th>Age Range (Years)</th>
<th>All #</th>
<th>All %</th>
<th>Graduate #</th>
<th>Graduate %</th>
<th>Ph.D. #</th>
<th>Ph.D. %</th>
<th>M.S. #</th>
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<td>1-5</td>
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<td>6190</td>
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<td>1932</td>
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<td>12748</td>
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<td>6582</td>
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<td>231</td>
<td>1.6%</td>
<td>545</td>
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<td><strong>Total</strong></td>
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<td>100%</td>
<td>22212</td>
<td>35.7%</td>
<td>7469</td>
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<td>23.7%</td>
<td>40006</td>
<td>64.3%</td>
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<tr>
<td><strong>Average Age (Years)</strong></td>
<td><strong>12.33</strong></td>
<td><strong>12.92</strong></td>
<td><strong>13.51</strong></td>
<td><strong>12.62</strong></td>
<td><strong>12.01</strong></td>
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<td></td>
</tr>
</tbody>
</table>

The graduate students cited a larger percentage of material that was less than one year old than did the faculty, which may indicate that they are scanning the literature regularly to keep up with information relating to the topic of their theses/dissertations. However, the faculty cited a higher percentage of material that was between 1-5 years old than the graduate students. Also, the faculty cited a higher percentage (83.860%) of items that were less than 20 years old compared with the graduate students (81.79%). The average age of publications cited by the
three groups range between 12.01 years for faculty and 12.92 years for the graduate students (13.51 years for Ph.D. and 12.62 for M.Sc).

Table 4 presents the age of journals and books cited combined for the graduate students and faculty. Of the journal articles cited, 74.57% were less than or equal to 15 years, while 59.4% of the books cited were in this age group. Of the journal articles cited, 21.80% of them were between 16 to 40 age group, while a larger percentage (34.5%) of the books were in this age group. Just 3.52% of the journal articles cited were older than 40 years old, while 5.6% of the books were in this age category. Overall, the average age of journal citations (12.28 years) was less than the average age of the book citations (16.18 years). These findings suggests that the optimum age of a collection of journals is 20 years and for books, 30 years, to support research in food science.
Journal citations represent a significant portion of all citations in this study. The 100 most cited journals represent only a small portion of all the journal titles cited (2.7%); however, they contribute a disproportionate number of citations (58.6%). A similar pattern is exhibited when the faculty and graduate students’ citations are examined individually. The larger number of citations by the faculty is tied to the larger number (n=1,000) of faculty publications in the study than the graduate students (n=130); see Tables 5 and 6.
<table>
<thead>
<tr>
<th>Journal Titles</th>
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<th>Graduate</th>
<th>Ph.D.</th>
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<tbody>
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<td>Journal of Agricultural and Food Chemistry (0021-8561)</td>
<td>2345</td>
<td>4.4</td>
<td>1023</td>
<td>5.6</td>
<td>505</td>
</tr>
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<td>1845</td>
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<td>760</td>
<td>4.2</td>
<td>328</td>
</tr>
<tr>
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<td>1807</td>
<td>3.4</td>
<td>562</td>
<td>3.1</td>
<td>113</td>
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<tr>
<td>Poultry Science (0032-5791)</td>
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<td>185</td>
<td>1.0</td>
<td>70</td>
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To further study the characteristics of the scatter of the cited journals, the journals were grouped into four categories: those cited only once by all authors in the study, those cited 2-4 times, 5-9 times, and 10 times or more (Figure 2). Overall, 648 journals (17.6 %) were cited more than ten times and account for 85.3 % of all citations to journal articles. The remaining 14.7 % of all citations are scattered across 3,032 journals. Of these, 1,355 journals (36.8 %) were cited only once. The patterns in frequency of citations per journal were fairly consistent for graduate students and faculty.

![Fig. 2 All Publications: Scatter of Cited Articles in Journals](image)

For the graduate students’ citations, 272 journals (13.4 %) that were cited more than 10 times account for 76.8 % of their citations to journal articles. The remaining 23.2 % of their cited reference are scattered in 1,758 journals. Of these, 816 journals (40.2 %) were cited only once (see Figure 2a). For the faculty citations, 463 journals (14.6 %) that were cited more than 10 times account for 81.3 % of their citations to journal articles. The remaining 18.7 % of their cited reference are scattered in 2,716 journals. Of these, 1,341 journals (42.2 %) were cited only once (see Figure 2b).
Overlap of journals cited by graduate students and faculty

Of the 3,680 titles that were cited by the graduate students and faculty, 580 of them were common to all the groups. (see Figure 3). These 580 journals account for 78.2% of all the citations. The faculty cited 3,179 journals; of these titles, 51.9% were cited only by the faculty. Dissertations cited 26.9% of these shared titles, and the theses cited 39.5%. The journals most frequently cited only by faculty are *Applied Physics Letters*, *Molecular and Cellular Probes*, *European Journal of Immunology*, *American Journal of Physiology – Renal physiology*, *Angewandte Chemie International Edition*, and *Comparative Biochemistry and Physiology Part A*.
Dissertations cited 1,032 journals; 14.1% of these journals were cited only by the doctoral students, while 82.9% of the titles cited were the same as the faculty and 59.3% were the shared with the theses. The theses cited 1,610 journals; of these 20.1% were cited only by the masters students, while 77.9% were shared with the faculty and 38.0% were shared with the dissertations. The journals most frequently cited by the graduate students are *Journal of Pesticide Science, Motivation and Emotion, Journals of Gerontology,* and *Journal of Pathology and Bacteriology.*

These results indicate that there exists a common group of 580 journals that account for 78.2% of all the citations common to both faculty and graduate students. This represents the preferred set of journals to satisfy most of the needs of food science researchers. These findings corroborate the conclusions of McCain and Bobick (1981), Zipp (1996) and McCullough (2016).

**Journal citation categories and ranking of cited journal**

To identify the multidisciplinary or interdisciplinary nature of research in food science dissertations, theses, and research from this department, and the extent that the researchers cite ranked journals, we checked whether the cited journals were indexed in the Clariviate Analytics Incites Journal Citation Reports (JCR). If they were identified in this source, we recorded the categories and their ranking within these categories. In many instances, a journal is assigned to multiple categories with different rankings within each of the categories. When this was the case, we chose the category with the highest ranking to represent the journal.

Seventy-three percent of the cited journals in the study were found in JCR. These journals were identified under 193 unique categories, indicating that our researchers and graduate students in food science are working in areas across multiple disciplines. Most of these
cited journals are in JCR Quartile 1 (42.6 %) and Quartile 2 (27.6 %); 18.6 % are in Quartile 3 and 11.2 % in Quartile 4.

Table 7 shows the JCR categories with 25 or more cited journals assigned to them. Since JCR rankings are based on citation counts, it can be assumed that the categories with the highest number of journals cited in this study are reflective of the foci of research in the food science department. According to their website (Food Science, Faculty Research Areas, 2020), the focus

<table>
<thead>
<tr>
<th>JCR Categories</th>
<th>Journals</th>
<th>Assigned Quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHARMACOLOGY &amp; PHARMACY</td>
<td>111</td>
<td>42 30 18 21</td>
</tr>
<tr>
<td>FOOD SCIENCE &amp; TECHNOLOGY</td>
<td>104</td>
<td>32 29 22 21</td>
</tr>
<tr>
<td>BIOCHEMISTRY &amp; MOLECULAR BIOLOGY</td>
<td>80</td>
<td>32 25 16 7</td>
</tr>
<tr>
<td>PLANT SCIENCES</td>
<td>77</td>
<td>40 17 12 8</td>
</tr>
<tr>
<td>VETERINARY SCIENCES</td>
<td>76</td>
<td>28 18 21 9</td>
</tr>
<tr>
<td>PUBLIC, ENVIRONMENTAL &amp; OCCUPATIONAL HEALTH</td>
<td>69</td>
<td>28 21 11 9</td>
</tr>
<tr>
<td>BIOTECHNOLOGY &amp; APPLIED MICROBIOLOGY</td>
<td>68</td>
<td>17 18 20 13</td>
</tr>
<tr>
<td>MICROBIOLOGY</td>
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<td>20 15 15 15</td>
</tr>
<tr>
<td>NUTRITION &amp; DIETETICS</td>
<td>48</td>
<td>22 9 9 8</td>
</tr>
<tr>
<td>MEDICINE, GENERAL &amp; INTERNAL</td>
<td>46</td>
<td>20 12 10 4</td>
</tr>
<tr>
<td>ENDOCRINOLOGY &amp; METABOLISM</td>
<td>46</td>
<td>19 18 5 4</td>
</tr>
<tr>
<td>GENETICS &amp; HEREDITY</td>
<td>44</td>
<td>21 14 5 4</td>
</tr>
<tr>
<td>ENVIRONMENTAL SCIENCES</td>
<td>43</td>
<td>18 11 8 6</td>
</tr>
<tr>
<td>ECONOMICS</td>
<td>43</td>
<td>17 18 6 2</td>
</tr>
<tr>
<td>ENGINEERING, CHEMICAL</td>
<td>41</td>
<td>13 12 9 7</td>
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<tr>
<td>ONCOLOGY</td>
<td>40</td>
<td>18 9 8 5</td>
</tr>
<tr>
<td>AGRONOMY</td>
<td>40</td>
<td>14 15 6 5</td>
</tr>
<tr>
<td>CHEMISTRY, MULTIDISCIPLINARY</td>
<td>40</td>
<td>9 8 9 14</td>
</tr>
<tr>
<td>BIOPHYSICS</td>
<td>37</td>
<td>18 10 7 2</td>
</tr>
<tr>
<td>IMMUNOLOGY</td>
<td>35</td>
<td>12 12 9 2</td>
</tr>
<tr>
<td>PSYCHOLOGY, EXPERIMENTAL</td>
<td>34</td>
<td>13 9 6 6</td>
</tr>
<tr>
<td>AGRICULTURE, DAIRY &amp; ANIMAL SCIENCE</td>
<td>32</td>
<td>10 10 6 6</td>
</tr>
<tr>
<td>BIOLOGY</td>
<td>31</td>
<td>15 7 2 7</td>
</tr>
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<td>INFECTIOUS DISEASES</td>
<td>31</td>
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<tr>
<td>CHEMISTRY, ANALYTICAL</td>
<td>30</td>
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<tr>
<td>AGRICULTURE, MULTIDISCIPLINARY</td>
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<td>29</td>
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<tr>
<td>ECOLOGY</td>
<td>28</td>
<td>16 7 3 2</td>
</tr>
<tr>
<td>MEDICINE, RESEARCH &amp; EXPERIMENTAL</td>
<td>28</td>
<td>10 7 6 5</td>
</tr>
<tr>
<td>CELL BIOLOGY</td>
<td>27</td>
<td>9 7 8 3</td>
</tr>
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<td>NEUROSCIENCES</td>
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<td>11 8 2 5</td>
</tr>
<tr>
<td>PEDIATRICS</td>
<td>25</td>
<td>13 8 2 2</td>
</tr>
</tbody>
</table>

Table 7 shows the JCR categories with 25 or more cited journals assigned to them. Since JCR rankings are based on citation counts, it can be assumed that the categories with the highest number of journals cited in this study are reflective of the foci of research in the food science department. According to their website (Food Science, Faculty Research Areas, 2020), the focus
of teaching and research in this department are food chemistry and biochemistry, food microbiology and safety, food processing and engineering, sensory and consumer science, and human nutrition.

As shown in Figure 4, 108 of the 193 categories assigned to the cited journals are common to the dissertations, theses, and faculty research publications. The dissertations only cite journals from the same categories as the faculty and theses. The faculty research cited journals from 190 categories, with 40 of the categories being unique to the faculty. The theses cited journals in 138 of these categories and the dissertations in 120. These results indicate that the dissertations, theses, and faculty research are using the journals assigned to the same categories for the most part. This is expected as graduate students normally undertake research in the same area as their supervisors. This result further indicates that the faculty are citing material from a range of other subject areas that account for a wider scatter of the journals. As is expected, these data also indicate a close coupling of the research areas of the faculty research and that of the dissertation and theses.

![Fig. 4 All Journal in JCR Categories - Only Best Category Selected](image)
Publishers

The graduate students and faculty cited 53,153 articles in 3,680 journals. These journal titles were checked in Ulrich’s Web Global Serials Directory to identify the publishers, and 2,721 of the journal titles were found associated with 578 publishers. These titles contain 51,382 (96.67%) of all cited articles. The remaining 959 titles were not listed in Ulrich’s; however, most (816) were cited only once.

Table 8 shows the major cited publishers. These publishers have 12 or more journals assigned to them and represent 68.7% of the journal titles and contribute 78.9% of the journal citations with identified publishers. Publishers not listed in Table 8 that are worth mentioning are International Association for Food Protection (4 journals, 3.7% of citations); American Society of Agricultural and Biological Engineers (3 journals, 1.5% of the citations); Public Library of Science (6 journals, 0.8% of citations); and Microbiology Society (7 journals, 0.7% of citations). This information indicates that it may be useful to monitor the publications from these publishers for material that may be desirable to add to a library’s collection in food science.
<table>
<thead>
<tr>
<th>Publisher</th>
<th>Titles</th>
<th>%</th>
<th>Articles</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elsevier</td>
<td>473</td>
<td>17.4</td>
<td>12220</td>
<td>23.8</td>
</tr>
<tr>
<td>Wiley</td>
<td>362</td>
<td>13.3</td>
<td>9360</td>
<td>18.2</td>
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<tr>
<td>Springer</td>
<td>215</td>
<td>7.9</td>
<td>1826</td>
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<td>Taylor and Francis</td>
<td>114</td>
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<tr>
<td>Oxford University Press</td>
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<td>3.3</td>
<td>2821</td>
<td>5.5</td>
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<tr>
<td>Sage Publications</td>
<td>65</td>
<td>2.4</td>
<td>396</td>
<td>0.8</td>
</tr>
<tr>
<td>Academic Press</td>
<td>62</td>
<td>2.3</td>
<td>1459</td>
<td>2.8</td>
</tr>
<tr>
<td>BioMed Central</td>
<td>51</td>
<td>1.9</td>
<td>427</td>
<td>0.8</td>
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<tr>
<td>Lippincott Williams and Wilkins</td>
<td>51</td>
<td>1.9</td>
<td>258</td>
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<tr>
<td>Nature Publishing Group</td>
<td>42</td>
<td>1.5</td>
<td>819</td>
<td>1.6</td>
</tr>
<tr>
<td>American Chemical Society</td>
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<td>1.5</td>
<td>2863</td>
<td>5.6</td>
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<tr>
<td>Cambridge University Press</td>
<td>38</td>
<td>1.4</td>
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<td>1.7</td>
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<td>Routledge</td>
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<td>1.2</td>
<td>172</td>
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<td>Annual Reviews</td>
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<td>1.0</td>
<td>265</td>
<td>0.5</td>
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<tr>
<td>American Society for Microbiology</td>
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<td>0.8</td>
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<tr>
<td>Hindawi</td>
<td>21</td>
<td>0.8</td>
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<td>RSC Publications</td>
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<tr>
<td>Bentham Science Publishers</td>
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<td>American Psychological Association</td>
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<td>0.6</td>
<td>167</td>
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<td>American Physiological Society</td>
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<td>0.5</td>
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<td>Mary Ann Liebert</td>
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<td>Canadian Science Publishing</td>
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<td>0.4</td>
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<td>Karger Publishers</td>
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<td>0.4</td>
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</tbody>
</table>
Conclusion

Our study found that the average number of citations in dissertations were 249, 147 for theses, and 40 for faculty publications. Most frequently, cited references from the dissertations, theses, and faculty were to journal articles, followed by books and monographic series. The ratio of journal articles cited to all other publications types, as well as the ratio of journal articles to books cited, were greater for faculty publications than for the dissertations and theses. The graduate students, especially the doctoral students, cited a larger percentage of materials that were less than one year old. On average, the faculty cited fewer government related documents and web resources than did the dissertations and theses.

There is no major difference in the age of material cited by the three groups. These data would suggest that the age of an optimum collection of material to support research in this area would be less than 20 years for journals and less than 30 years for books. In addition, this collection should include items from the top cited 100 journals contribute 58.6 % of all cited references. There is not much variation in the top 100 journals cited by the three groups, ranging from 58.9 % of all cited journals for the faculty, 63.0 % for the dissertations and 59.0 % for the theses. Similar results were found by McCain and Bobick (1981) and Zipp (1996) when they compared citations to journal articles found in faculty publications and theses and dissertations in biology and geosciences, respectively.

We identified 580 journals that accounted for more than three-quarters of all the citations that were in common among the three groups. As is expected, a large percentage of the journals cited by the graduate students cited were also cited by the faculty. The faculty cited a broader range of journals that included some unique only to their publications. This variation may be tied to collaborations with 32 other departments in their research, and there was a large number
of faculty publications during this period. The data would suggest that the graduate students’ research is more focused on research internal to the department.

Of the 193 JCR categories assigned to all the cited journals, 108 of them overlapped with all three groups as was expected. The largest deviation from this core were journals cited by the faculty, again indicating that they are involved with multidisciplinary collaborative research.

In addition to providing information on the types of material and the top journals that food science researchers cite and use, the findings from this study also provide data for evidenced-based collection development. It will inform any decisions in validating how well the library’s collections are meeting the research and instruction needs of their campus users. Citation analyses of undergraduate theses, grants, and patent applications can further complement studies like this. Librarians can use this information in outreach activities, to support conversations with relevant faculty about the characteristics of their publications and how well the libraries provide access to the materials that used and cited in their research.

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