

ORIGINAL ARTICLE

Scientific Literacy for Safe Use of Plant-Based Products and Dietary Supplements

Marcela Forgerini¹, Geovana Schiavo²,
Gabriela Barbosa Nascimento³, Patrícia de Carvalho Mastroianni⁴

Highlights

1. A successful health literacy experience on social media is presented.
2. A reproducible methodology for the knowledge translation process was proposed.
3. The need to converge popular knowledge with scientific evidence was addressed.

ABSTRACT

The “@encapsulando.unesp” is promoted by high school and undergraduate students in pharmacy, medicine, nursing and nutrition; postgraduate students; post-doctoral fellows and professors from four universities with the aim of spreading technical-scientific literacy on the use of plant-based products (PBP) and dietary supplements (DS). The following activities were conducted: a) reading, comprehending and evaluating the quality of scientific articles; b) preparation of technical scripts and educational materials in language accessible to the population, and c) dissemination of materials on social networks. The themes were defined based on social demands on the treatment and prevention of Covid-19 and its sequelae, in addition to the dialog with popular knowledge about the use of PBP and scientific evidence. Over a period of two years, 105 students analyzed 783 scientific articles and created 164 teaching materials that reached 49,736 users on social networks. A total of 15 scientific initiation projects were developed, along four course completion studies. Additionally, nine abstracts were presented at scientific events, and three books were published. Aligned with the United Nations’ goal of providing quality education for sustainable development, the project has promoted the rational use of PBP and DS, contributing to health literacy and strengthening the relationship between the university and society.

Keywords: Information Dissemination; Interdisciplinarity; Health Literacy; Medicinal plants; Nutritional Supplementation.

¹ São Paulo State University (Unesp). School of Pharmaceutical Sciences. Araraquara/SP, Brazil. <https://orcid.org/0000-0002-2905-8519>

² São Paulo State University (Unesp). School of Pharmaceutical Sciences. Araraquara/SP, Brazil. <https://orcid.org/0000-0001-9502-6155>

³ São Paulo State University (Unesp). School of Pharmaceutical Sciences. Araraquara/SP, Brazil. <https://orcid.org/0000-0002-2046-3745>

⁴ São Paulo State University (Unesp). School of Pharmaceutical Sciences. Araraquara/SP, Brazil. <https://orcid.org/0000-0001-8467-7278>

INTRODUCTION

After the increase in reports of cases of infection by the SARS-CoV-2 virus (Covid-19) in the world and the absence of medicines or vaccines for the prevention or treatment of the infection, in March 2020, the World Health Organization declared a new pandemic and recommended the adoption of control measures (e.g., hand hygiene, use of masks and quarantine)¹. Covid-19 rapidly became the main cause of morbidity and mortality, in addition to causing financial and humanistic impacts, such as costs to the health system, loss of productivity and quality of life².

Currently, Covid-19 has reached the mark of 670,604,232 confirmed cases and 6,844,415 deaths in the world (data from February 6, 2023)³. The scenario created by the pandemic, combined with the lack of knowledge of prevention measures, control, treatment and management of the infection and its consequences, caused insecurity, panic and fear in the population. This situation was aggravated by the constant dissemination of fake news on social networks⁴.

In the search for alternative and preventive treatments for Covid-19, there was an observable increase in the consumption of dietary supplements (DS) and plant-based products (PBP) by the population^{5,6}. This increase is justified by the easy access to these products, such as the lack of a requirement for a medical prescription and their perceived effectiveness in other health conditions. Consequently, these products were often out of stock in pharmacies across the country.

Alongside the increase in Covid-19 cases, there has been a rise in mental and behavioral disorders, such as anxiety, panic attack and depression⁷, and some DS have been used as an adjuvant therapy to improve or prevent these disorders⁸. One example of DS is probiotics - live microorganisms that act on the balance of the gut microbiota and the central nervous system (gut-brain axis). When consumed in adequate amounts, probiotics can provide health benefits, including mental health improvements⁹. However, despite their benefits, some probiotics can be associated with adverse events, such as bacteremia, fungemia and sepsis in immunocompromised individuals when used improperly¹⁰.

The use of PBP, a term that encompasses medicinal plants, herbal drugs, herbal derivatives and phytotherapies¹¹, also increased to prevent, manage and treat signs and symptoms of Covid-19⁶. An example of PBP is Neem (*Azadirachta indica* A. Juss.), whose leaf extract is traditionally used to reduce fever and has been used in mild cases of Covid-19 due to its immunomodulatory and anti-inflammatory effects¹². However, there are reports that the seed oil, which also has an immunomodulatory effect, can cause metabolic acidosis and kidney injury¹².

In this context, despite the frequent and popular use of DS and PBP, most of the population remains unaware of the potential safety risks associated with these products, such as adverse events and drug interactions¹³. Reports of serious adverse events, including hospitalizations and deaths resulting from the inappropriate and abusive use of these products, have become increasingly common on social media^{14,15}. One example of a serious adverse event associated with the use of PBP was the case of a 42-year-old nurse who died as a result of fulminant hepatitis induced by the use of capsules containing various medicinal plants for weight loss¹⁴, including plants known for their hepatotoxicity, such as green tea (*Camellia sinensis*)¹⁶.

Given this pandemic scenario and the search for alternatives for the prevention and management of Covid-19, added to the significant volume of circulating information that is dubious and lacks scientific backing, it was proposed to promote health literacy among the population, healthcare professionals and managers concerning the rational and safe use of DS and PBP. The activities are conducted at the School of Pharmaceutical Sciences (FCFAR) of the São Paulo State University "Júlio de Mesquita Filho" (Unesp) through the university extension project "*Dissemination of scientific knowledge and knowledge translations about dietary supplement (DS) and food-based*

plant products (PBP) and dissemination through the social media of the University Pharmacy”, known on social networks as “@encapsulando.unesp”.

The extension project promotes health literacy on the use of DS and PBP through the translation of technical-scientific knowledge based on social needs and demands to promote their rational and safe use. The multidisciplinary and interdisciplinary, as well as interinstitutional activities, are based on the inseparability of Teaching, Research and Extension.

METHOD

Composition of the team

The @encapsulando.unesp project team comprises professors specializing in Pharmaceutical Care, Pharmacognosy, Pharmacobotany and Nutrition, as well as postdoctoral researchers, postgraduate students from the Pharmaceutical Sciences and Food and Nutrition Programs and undergraduate students from the Pharmacy, Medicine, Nutrition and Biological Sciences courses. The team involves the institutions Unesp, University of Araraquara (Uniar), University of Sorocaba (Uniso) and University of Santo Amaro (Unisa). Additionally, the project offers positions to high school students from public schools in Araraquara, aiming to provide them with their first contact with scientific reading and the university environment.

Organizational chart of activities developed

Interfacing with research and teaching, the project develops scientific initiation projects, course completion studies, and organizes and promote scientific events open to the public. It also offers opportunities for supervised curricular internships related to the specificities of the educational institution.

To support high school and undergraduate students in the development of their activities, scholarships are sought from various sources, including the *Pró-reitoria de Extensão e Cultura* of Unesp (Proec), Institutional Program for Scientific Initiation Scholarships (Pibic – undergraduate and secondary education), National Council for Scientific and Technological Development (CNPq), Student Permanence Coordination (Cope) and Unesp Present (Notice Nº 01/2021-PROGRAD/PROPE/PROEC/ACI/AUIN-Aid for Unesp students)

The team meets biweekly to plan the workflow and define the themes to be developed.

1) *Interdisciplinary theoretical-practical training*

The aim of training is to level the knowledge of project participants in the search for scientific evidence, reading and critical interpretation of studies. During this phase, the concept and aims of translating the technical-scientific knowledge are introduced.

Discussions are held on the development of search strategies for scientific articles in databases, choice of health descriptors, forms of access to studies, such as through institutional channels and ResearchGate® (<https://www.researchgate.net/>). Moreover, the team reflects on the amount of information that is produced daily and the need for a critical approach to this evidence¹⁷. The issue of predatory journals, which do not comply with good research ethics practices and are a growing concern in scientific production, is also covered.

Students are equipped with tools for methodological and reporting quality analysis, enabling critical reading of studies and the identification of potential limitations. In the era of (mis)information and the dissemination of fake news, especially intensified during the pandemic, it is essential to understand and apply the instruments.

Scientific literacy is promoted through discussions within the context of the ancestral and cultural use of PBP and DS, highlighting its aims and the relationship with everyday life and social demands.

The concept of translating technical-scientific knowledge consists of disseminating the research data in an accessible and didactic manner for the general population, academics, health professionals and health managers. The objective is to break down the “walls” of universities, reducing the distance between the sphere of the university and health practice¹⁸. Metaphorically speaking, the aim is to dismantle the “ivory tower” university model and address the demands and needs of society.

This is a continuous and interactive process that involves the synthesis, exchange, dissemination and application of science (Figure 1). Didactics and accessibility are key points.

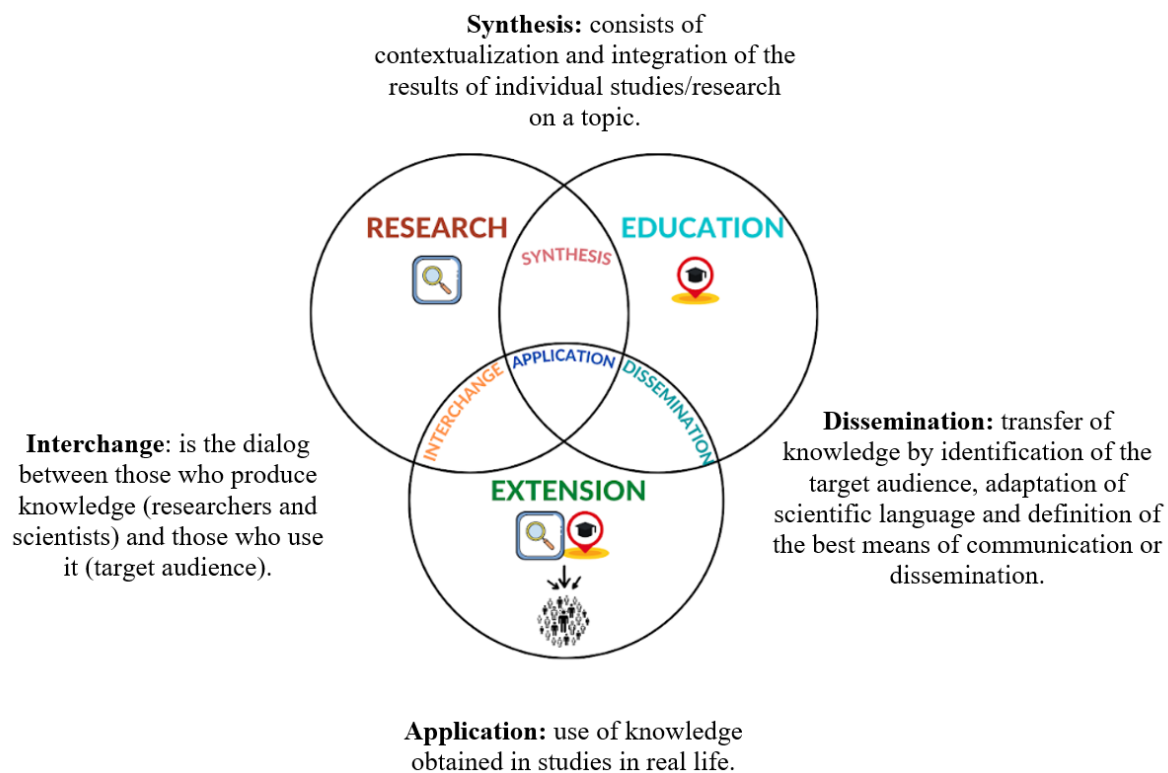


Figure 1 – Process of translating technical-scientific knowledge.

Source: Prepared by the authors and adapted¹⁸.

2) Selection of studies and preparation of a technical script

The study to be worked on during the translation of technical-scientific knowledge is selected according to the social demands and suggestions from PBP and DS users, as well as followers of the project’s social networks. Depending on dem, thematic series are designed on specific health conditions, such as cognitive impairment, diabetes *mellitus*, or specific populations, such as athletes and physically active individuals.

To survey scientific articles, search strategies are developed with health descriptors (<https://decs.bvsalud.org/>), MeSH terms (<https://www.ncbi.nlm.nih.gov/mesh/>) and Boolean operators (AND, OR, NOT). These aspects are previously introduced during theoretical-practical training. The survey and preparation of the technical script are carried out by two project members under the supervision of at least one professor and either one postdoctoral researcher or one postgraduate student.

During the preparation of the script to be disseminated, technical terms and terminologies are presented in a simplified and didactic manner. The scientific article analyzed is described considering

its methodology, results and conclusion, including any possible limitations of the study, which are identified by the students using reporting and methodological quality analysis instruments.

When the scripts include the presentation of a PBP and its method of use and preparation, documents prepared and recommended by the Ministry of Health and the National Health Surveillance Agency (Anvisa) are used. These include the Brazilian Pharmacopoeia Herbal Medicines Form and Brazilian Pharmacopoeia – Plants Medicinal^{19,20}. These documents were developed to assist professionals in different health services (e.g., pharmacies, live pharmacies, and basic health units) in handling, prescribing, dispensing and providing guidance on the correct and rational use of PBP.

3) Preparation of audiovisual material

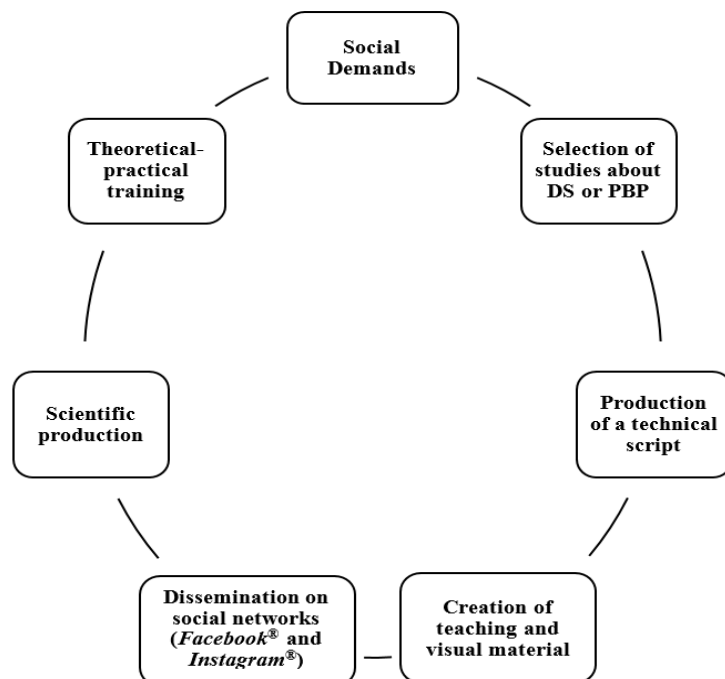
To guarantee access to scientific information, it is necessary to use strategies that guarantee access in an understandable easy-to-interpret manner, ensuring effective dissemination and meeting societal needs. For this purpose, teaching material are prepared based on the technical script, utilizing figures, diagrams, flowcharts and conceptual maps. These materials can be created in the form of sequential images (carousel) or videos using the Canva® program (<https://www.canva.com/>).

The educational materials created by the project are made available on social media platforms: *Facebook*® (<https://www.facebook.com/profile.php?id=100070931594238>) and *Instagram*® (<https://www.instagram.com/encapsulando.unesp/>).

4) Scientific production

Following steps 2 and 3, reflections on scientific production are encouraged based on the material developed during the translation of technical-scientific knowledge. Books are written about the series of thematic posts produced, and project data and metrics are collected for writing manuscripts and abstracts to be present at national and international scientific events.

The work process is continuous, providing feedback and is motivated by news and social demands (Figure 2).



DS: dietary supplements; PBP: plant-based products.

Figure 2 – Encapsulated organization chart of project work.

Source: Prepared by the authors (2023).

RESULTS AND DISCUSSION

Team, theoretical-practical training, organization of scientific events, obtaining grants and scientific production

Between March 2021 and February 2023, the multidisciplinary team of the project consisted of 109 members, including high school, undergraduate students, postgraduate students, postdoctoral researchers and teachers. Their work involved two postgraduate programs (Pharmaceutical Sciences and Food and Nutrition) and four universities (Unesp, Uniara, Uniso and Unisa). In total, 12 scholarships were obtained for project members (Table 1).

Table 1 – Description of the multidisciplinary team of the @encapsulando.unesp project and the obtaining of scholarships between March 2020 and February 2023, Araraquara, São Paulo

Indication	Number (N)
Multidisciplinary team of the project	109
High school students	5
Undergraduates	85
Postgraduate students	13
Postdoctoral researchers	2
Professors	4
Obtaining scholarships	14
Unesp Present Scholarship	7
COPE Scholarship	2
PROEC Scholarship	2
PIBIC-CNPq Scholarship - High School	2
PIBIC-CNPq Scholarship	1

CNPq “National Council for Scientific and Technological Development; **Cope**: Coordination of Student Permanence; **Pibic**: Institutional Scientific Initiation Scholarship Program; **Proec**: Dean of University Extension and Culture; **Unesp Present** Notice No. 01/2021-PROGRAD/PROPE/PROEC/ACI/AUIN-Aid for Unesp students.

Source: Prepared by the authors (2023)

During this period, five theoretical-practical training sessions were offered to members of the project team, with the aim of achieving reliable and acceptable translation of technical-scientific knowledge for the population. Moreover, three scientific events open to the public were organized.

A total of 15 scientific initiation or extension projects and four course completion projects were developed with the following themes: the use of DS in cognitive impairment of older people and by athletes and physically active people; and use of PBP in uterine health and by people living with diabetes *mellitus* (Table 2).

Table 2 – Description of the theoretical-practical training provided, organization of scientific events, collection of evidence and scientific production from March 2020 to February 2023, Araraquara, São Paulo

Indicator	Quantity (N)
Theoretical-practical training sessions	5
Scientific evidence and quality analysis of scientific articles	2
Translation of technical-scientific knowledge	2
Introduction to dietary supplements	1
Organization of Scientific Events	3

Round of Conversation: “Plant-based products: the union between popular knowledge and the empathy of healthcare professionals”	1
Lecture: “Activities of the multidisciplinary team in dietary supplementation in athletes”	1
Round Table: “Translation of knowledge to the digital environment”	1
Survey of evidence	790
Scientific articles analyzed	783
Official documents prepared by the Ministry of Health and Anvisa	7
Axis of technical scripts prepared	150
DS	75
Athletes and practitioners of exercise and physical performance	20
The older person and cognitive function	15
Mental health (use of probiotics and psychobiotics)	14
Other axes	26
PBP	75
Diabetes <i>mellitus</i>	17
Weight loss	12
Religions of African Matrices	9
Respiratory disorders	8
Older Person	3
Health of the uterus	2
Other axes	24
Audiovisual materials produced	164
Scientific production	
Books (printed and digital format)	3
Evidence of the use of psychobiotics in mental health ²¹	1
Use of plant-based products in weight loss ²²	1
Plant-based product in diabetes <i>mellitus</i> ²³	1
Abstracts presented at scientific events	9
National event	7
International event	2
Abstracts published at annual national events	7

Anvisa: National Health Surveillance Agency; DS: dietary supplements; N: number; PBP: Plant-based products.

Source: Prepared by the authors (2023)

In total, 783 scientific articles and 7 official documents prepared by the Ministry of Health and Anvisa were analyzed, resulting in the production of 150 technical guides and 164 teaching materials.

Based on the scientific evidence produced and metrics obtained, three books were written, and nine abstracts were presented at national and international scientific events. The abstract entitled “*Translation and dissemination of scientific knowledge about herbal medicines and dietary supplements on social networks*” was presented at the international event “Iberoamerican Symposium of the Iberoamerican Conference of Pharmaceutical Faculties (COIFFA)” and received an honorable mention for third best scientific study presented (Table 2).

In 2022, by invitation, a post-doctoral student gave a lecture on the translation of technical-scientific knowledge at the national event “X Pharmaceutical Care Congress of Unesp/ VI Day of Bioprocess Engineering and Biotechnology”. The lecture was titled “*The translation of technical-scientific knowledge: from the search for evidence to the democratization of knowledge*”. Additionally, a professor coordinating the project gave a conference titled “*Phytovigilance: adverse events and quality of plant-based products (PBP)*” at the XXX Peruvian Scientific Congress of Pharmacy and Biochemistry Students, in Arequipa, Peru.

Democratization of technical-scientific knowledge

In June 2021, the first educational materials were released, introducing @encapsulando.unesp, its objectives and introductory educational content. These materials defined PBP and DS, described types and pharmaceutical forms of DS (e.g., capsules and powders), and discussed safety risks associated with the use of medicinal plants (e.g., adverse events and drug interactions). Related concepts, such as live pharmacies, ethnobotany and ethnopharmacology, were also covered.

Encouraged by social demand and in response to the pandemic, thematic series were initiated addressing the epidemic of anxiety and depression, which paralleled Covid-19 and boosted the consumption of DS, particularly probiotics²⁴. The first series consisted of 14 videos that addressed the evidence for the use of probiotics, especially those belonging to the genera *Lactobacillus* spp. and *Bifidobacterium* spp., for individuals diagnosed with bipolar affective disorder, anxiety, autism and depressive spectrum, Alzheimer’s disease, sleep disorders and stress reactions. As a result of these disclosures, an open access book was published, available in both print and digital versions (*e-book*), aimed at promoting the rational and safe use of probiotics in mental health cases²¹.

As an ongoing result of the pandemic, sequelae of Covid-19 infection, particularly related to cognitive function in the older adults, were observed.^{25,26} To avoid the irrational use of DS to prevent or improve cognitive impairment in this population, a second series was developed. This series included 15 teaching materials presenting the characteristics of older person, definitions of different types of cognitive impairment and scientific evidence on the use of omega-3 and B vitamins and their outcomes on cognitive function.

The first thematic series concerning the use of PBP also prioritized older people, due to their widespread use of medicinal plants and the greater risk of adverse events and drug interactions in this subpopulation²⁷. Three videos were created to present the indications, risks and possible alternatives to the use of ginkgo (*Ginkgo biloba*), belladonna (*Atropa belladonna*), aloe vera (*Aloe vera*), sacred bark (*Rhamnus purshiana*) and senna (*Senna alexandrina*), which are PBP frequently associated with adverse events²⁸.

Ginkgo, used to improve memory, and belladonna, used for digestive and gastrointestinal problems, are associated with a potential risk of falls and fractures. Aloe vera, sacred bark and senna, widely used to manage constipation, can worsen clinical condition and cause intestinal irritation^{28,29}. For management, osmotic laxatives and healthy lifestyle habits, such as adequate water and fiber intake, are preferable²⁸.

Further guidance was identified as necessary commonly used medicinal plants, such as chamomile (*Matriarca recutita* L.), cinnamon (*Cinnamomum verum* J. Presl), ginger (*Zingiber officinale* Roscoe), ginseng (*Panax ginseng*), guaraná (*Paullinia cupana* Kunth ex H.B.K. var. *sorbilis* (Mart.)), melissa (*Melissa officinalis* L.) and “stonebreaker” (*Phyllanthus niruri* L.). Information provided include indications for use, preparation methods, warnings, adverse events and potential drug interactions.

Another problem identified was the abusive use of PBP for weight loss, highlighted by the death of the nurse due to the use of “50 herb” capsules to lose weight,¹⁴ which led to Anvisa publishing a warning about the risks associated with the use of medicinal plants. With the purpose of promoting the safe use of PBP, 12 educational materials were produced, covering 10 medicinal plants commonly used to help with losing weight, such as horsetail (*Equisetum arvense* L.), green tea (*Camellia sinensis*) and hibiscus (*Hibiscus sabdariffa*). Each post detailed the indications for use, evidence regarding weight loss, preparation methods, warnings and contraindications and possible adverse events and drug interactions. As a result, a second open-access book was published to promote the safety of medicinal plants users seeking weight loss²².

During the preparation of this series, a lack of quality information on the use of PBP for weight loss was identified. There was a need to map all available evidence on this topic by conducting a systematic scoping review, involving two undergraduate students. The results of this review will be presented at scientific events and teaching materials will be prepared for dissemination on @encapsulando.unesp social networks. Additionally, a manuscript will be written based on the obtained data.

To align scientific evidence with the traditional and ancestral knowledge of African-based religions, a series was created on the use of PBP in ritualistic contexts. This series presented medicinal plants associated with Orixás, the spiritual temperature of herbs, evidence of their use in ceremonies and rituals, therapeutic properties, forms of consumption, contraindications and warnings. In total, 13 teaching materials were created covering the following PBPs: Xango and pomegranate (*Punica granatum*), Obaluaiyê and aloe vera (*Aloe vera*), Iemanjá and lavender (*Lavandula officinalis*), Iansã and cloves (*Syzygium aromaticum*), Oxóssi and pitangueira (*Eugenia uniflora*), Oxum and capeba (*Pothomorphe umbellata*), Oxalá and boldo (*Peumus boldus*), Ossain and quebra-pedra (*Phyllanthus niruri*), Ogum and eucalyptus (*Eucalyptus globulus*) and Exu and Ginger (*Zingiber officinale*). Figure 3 illustrates some of the covers of the scientific literacy materials published on the social networks of the university extension project @encapsulando.unesp (Figure 3).



Figure 3 – Audiovisual materials created and disseminated on the project social networks @ encapsulando.unesp.

Source: Created by the authors (2023).

Materials posted on social networks

Up until March 2023, 164 educational materials had been disseminated on social networks, comprising 131 visual arts and 33 videos, reaching 43,059 accounts on *Instagram*[®] and 6,677 accounts on *Facebook*[®] (Table 3). Most of the audience reached consisted of women (73,5% on *Instagram*[®] vs 77,3% on *Facebook*[®]) in the age range of 18 and 24 years.

Table 3 – Performance metrics of the 164 posts on social media (*Instagram*[®] and *Facebook*[®]) from June 2021 (first publication) to March 2023

Theme	Publication	Reach	Impressions	Sharing	Likes
Instagram[®]					
DS	53	14,685	22,759	646	2,225
PBP	50	12,130	18,585	407	2,140
Introduction/ concepts ^a	61	16,244	24,925	1,127	2,855
Sub-total	164	43,059	66,269	2,180	7,220
Facebook[®]					
DS	46	2,095	2,369	26	114
PBP	44	2,451	2,771	24	119
Introduction/ concepts ^a	38	2,131	2,500	25	78
Sub-total	128	6,677	7,640	75	311
TOTAL	161	49,736	73,909	2,255	7,531

Survey conducted on March 10, 2023.

DS: dietary supplements; **PBP:** plant-based products.

^a Content related to the introduction of important themes and concepts, such as the definition of DS, PBP, and introductory texts about the series developed.

Instagram[®]: <https://www.instagram.com/encapsulando.unesp/>

Facebook[®]: <https://www.facebook.com/profile.php?id=100070931594238>

Source: Prepared by the authors (2023).

The metrics, scope and content development methods suggest that the university extension project @encapsulando.unesp corroborated the objectives of quality education, health and well-being of the United Nations Sustainable Development plan³⁰ The aims of the proposed health literacy project include guaranteeing quality health and education, democratizing access to scientific evidence, promoting effective communication between academia and society, and respecting popular knowledge¹⁸.

Future perspectives

Considering the project's relevance for academic training, the importance of disseminating technical-scientific knowledge for health promotion, user safety and the significant reach of the produced teaching materials, the following prospects are identified: (i) establishing new partnerships and collaborations with other national and international institutions; (ii) including new themes, especially those of interest to specific groups, thereby ensuring the inclusion of minorities; (iii) organizing and participating in educational fairs for communities to guide the safe and rational use of PBP and DS; (iv) providing seedlings of medicinal plants of identified and known origin, along with guidance on cultivation, harvesting and use; (v) preparing and publishing new open-access books for wide dissemination; (vi) developing new research projects to attract new scholarships; and (vii) continuing to promote discussions on the translation of technical-scientific knowledge in different areas of healthcare to empower the community and promote health literacy.

FINAL CONSIDERATIONS

The translation of knowledge and technical-scientific literacy on the use of PBP and DS have shown the inseparability of teaching, research, and extension through the execution of multi- and interdisciplinary activities. It has also encouraged interprofessional education among undergraduate students in pharmacy, medicine, nursing, and nutrition programs, as well as among postgraduate students.

The metrics and methodology used in content preparation suggest that the university extension project @encapsulando.unesp corroborates the objectives of quality education, health and well-being outlined in the United Nations Sustainable Development plan. It promotes the safe and rational use of PBP and DS, aiming to democratize technical-scientific knowledge, respect popular knowledge, and strengthen the relationship between the university and society.

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Authors' Contributions

Marcela Forgerini: Conceptualization, Project administration, Supervision, methodology, Data curation, Formal analysis, Validation, Writing – original draft, Writing – review & editing.

Geovana Schiavo: Data curation, Formal analysis, Validation, Writing – original draft, Writing – review & editing.

Gabriela Barbosa Nascimento: Data curation, Formal analysis, Validation, Writing – original draft.

Patrícia de Carvalho Mastroianni: Conceptualization, Funding acquisition, Project administration, Supervision, methodology, Data curation, Formal analysis, Validation, Writing – review & editing.

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Corresponding Author

Patrícia de Carvalho Mastroianni
São Paulo State University (Unesp). School of Pharmaceutical Sciences
Araraquara-Jaú Highway, Km 1, no number, Campos Ville, Araraquara/SP, Brazil.
patricia.mastroianni@unesp.br

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