Trends In Scientific Research on the Use of Residues from the Manufacture of Cassava Starch (Manihot Esculenta Crantz)

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Abstract:- Cassava is one of the main energy foods consumed in underdeveloped countries. Among cassava by-products, starch is the most valued, due to its wide use as raw material for food production. The industrial processing of cassava starch produces a large amount of waste, the improper disposal of this material can cause serious environmental problems. In this sense, this work aimed to investigate the scientific production on the study of the use of residues from the processing of cassava starch (Manihot esculenta Crantz) in the period from 2016 to 2021. For this, a qualitative, exploratory study was used. and bibliography. The categorization made it possible to identify a higher incidence of publications in the themes that deal with obtaining cassava starch and the development of biodegradable films for covering fruits and vegetables. Considering only the publications that address the residues from the processing of cassava starch, a predominance of publications that deal with products made from cassava bagasse was identified. Regarding the areas with the lowest incidence of publications, the categories of physical and functional properties of cassava starch and the category of residues from the manufacture of cassava starch have been highlighted. The categories of wastewater treatment (manipueira) and surfactant manufacturing processes from manipueira also presented a lack of publications. The results obtained allow identifying trends in publications on the subject as well as indicating opportunities for research development in less studied areas.

***Keywords:-** Cassava, Manipueira, Cassava Bagasse.*

I. INTRODUCTION

Cassava (Manihot esculenta crantz) is one of the main energy foods consumed by more than 700 million people, mainly in underdeveloped countries. The root is produced in more than 100 countries, with Brazil being the second largest producer in the world. Easy to adapt, the plant is cultivated in all Brazilian regions, the North (32.8%) and Northeast (29.7%) regions being the largest producers [12].

Among cassava by-products, starch is the most valued, due to its wide use as raw material for food production [7].

The industrial processing of cassava starch produces a large amount of waste with a high pollutant load. Improper disposal of these residues can cause serious environmental problems, such as contamination of rivers, soil, groundwater and fish mortality. The environmental impact caused by the inadequate treatment of cassava processing residues can be mitigated through actions that involve, firstly, the dissemination of knowledge about the sustainable possibilities of their use [18].

Thus, this work aimed to gather information from scientific research published through bibliographic research, with the objective of reporting the advances of research on the study of the use of residues from the processing of cassava starch (Manihot esculenta Crantz).

The development of this work is justified by the relevance of research related to environmental issues, especially nowadays, when the planet urges solutions that promote sustainability, combined with the scarcity and dispersion of research that address this issue. This research contributes as a source of punctual information on residues from the cassava starch manufacturing process, bringing together current and relevant data on the subject in a single document.

II. MATERIALS AND METHODS

According to the classification of Silveira & Gerhardt [27], the research developed is characterized as follows: in terms of nature, as qualitative; as for the objectives, as exploratory and as for the procedures adopted, as bibliographic.

According to the authors, qualitative research "proposes the analysis of narrated information in an organized, but intuitive, inductive way, considering that some subjective data cannot be quantified". Exploratory research, on the other hand, aims to "provide greater familiarity with the object of study". In turn, bibliographic research consists of "a systematic study of research already carried out and published in the specialized literature and available in scientific journals and books".

The research was delimited according to the search period, thematic areas, article selection criteria and types of publications. Thus, the following parameters were of interest for the research:

- Period: 2016 – 2021.
- Thematic Area: food, agricultural sciences, food science and technology, agricultural and biological sciences, food.
- Article selection criteria: original articles that address innovative uses of cassava starch in foods or as foods.
- File exclusion criteria: articles that do not deal with the object of study.
- Type of document: original scientific articles, theses and dissertations.

The articles were collected through access to scientific research portals, such as the Capes Theses and Dissertations Catalog, SciElo and ScienceDirect, using the keywords residues o cassava, cassava wast, manioc, manipueira, manioc bagasse, bagasse of Manihot Esculenta, obtaining scientific works that address the subject under study. A total of 51 articles were collected, 13 articles that did not portray the object of study were excluded, using 38 articles for the elaboration of the work.

III. REVIEW

The work carried out by Garcia et al. [16], analyzed the microbiological and physicochemical characteristics of cassava starch acid and cassava bagasse in order to evaluate their potential for use in food.

Was used a modular lamp (UV-C) to replace solar radiation in the reaction with lactic acid produced during fermentation to evaluate the expansion characteristics of sour cassava starch. The results indicated that the combination of acidification and ultraviolet radiation (bc) allow an expansion (11 cm3 g-1) superior to the commercial sour starch (8.24 cm3g-1) adopted as standard [4].

A development a low-cost solar dryer for drying sour starch, as an alternative to unprotected solar drying subject to physical contamination of the product [20].

The results of gelatinization of native cassava starch under different preheating and spray drying conditions. The variables of preheating temperature, starch concentration and preheating time were studied [23].

The development of a mixture for the production of gluten-free dry pasta, to serve the public affected by celiac disease. The macaroni was produced from cassava starch, peach palm bran and golden flaxseed. The dough, dried at 60 ºC, 75 ºC and 90 ºC, met the standards required by national legislation and was classified as rich in fibers [22].

The effect of adding sweet whey (45-65%) and octenyl succinic anhydride (OSA) modified cassava starch (0.8-1.2%) on the rheological properties of fermented dairy beverages. The fermented milk drink produced with the addition of 40.9% of sweet whey and 1.13% of cassava starch modified with OSA was considered by the authors as the one that presented the best indices for the rheological properties studied [17].

While Mesa et al [19], presented the results of the study on the effect of different types of modified cassava starches on the quality and textural properties of gluten-free cheese bread produced with frozen dough. For this purpose, (extra, espresso and yucauca) and two chemically modified starches (Expandex® (MCS) and Gel® Baking (OCS)) were used. Samples with sour cassava starch showed higher hardness and number of crumb pores. On the other hand, samples with OCS showed better overall appearance.

The work by Rodrigues studied several non-traditional sources of starch for the production of biodegradable films. Biodegradable films were prepared with three concentrations of starch (2%, 3% and 3.5%) for each of the following sources: cassava, yam, jackfruit seed and mango seed [21]. The sources showed good physical, optical (such as transparency) and mechanical characteristics, mainly tensile strength whose maximum value was 36.63 Mpa.

A potential of the application of cassava starch-based coatings (F), additives of yerba mate extract (E) (Ilex paraguariensis St. Hill), in peach conservation [24]. Uncoated fruits and fruits with cassava starch coating were used. The samples were stored for 10 days at 1º C, with 95% relative humidity. Subsequently, physical-chemical analyzes were carried out. The use of the coating reduced the mass loss by 50%, increased the soluble solids content and intensified the red color of the fruits.

The research by Schmidt et al. [25], analyzed the hygroscopicity and mechanical properties of films developed from acetylated cassava starch. The cassava friend was subjected to the acetylation process with acetic anhydride resulting in starch acetates with degrees of substitution (DS) of

0.6 (S0.6) and 1.1 (S1.1). Twelve film formulations were tested: native cassava starch (S), starch acetate S0.6 and S1.1, with two concentrations of glycerol 0.25 g.100 g-1 (25%) and 0.30 g. 100 g-1 (30%). S0.6 films showed higher tensile strength (8.42 ± 0.84 MPa) than S1.1 films (6.93 ± 0.55 MPa). As a result, the production of films with improved mechanical properties, with lower water solubility and permeability to water vapor, was obtained.

The influence of edible coatings based on cassava starch and chitosan on the postharvest shelf life of Tommy Atkins mangoes. The fruits were covered with nine different coating formulations, stored at 25°C and evaluated for weight loss, color parameters, sensory attributes, CO2 production rate and microbiological contamination of the skins. The formulation containing 0.25% chitosan and 0.5% cassava starch showed more favorable results, increased shelf life by 3 days and presented lower CO2 production rates [5].

Evaluated the quality of minimally available table cassava. processed using antioxidants and starch-based edible coating. Table manioc roots were washed, cooled, immersed in cold water, cut and peeled. Then, immersed in chlorinated solution, centrifuged and immersed in starch suspension (3%) or in solution containing antioxidants (3% citric acid and 3% ascorbic acid) or both (coating + antioxidants). The results indicated that the use of antioxidants reduced browning in minimally processed table cassava pieces, keeping the pieces with quality, when stored for 15 days at 5 ± 2 ºC. The association of antioxidants with edible coating did not change the color reduction compared to the isolated antioxidants [9].

Carvalho et al [8] studied the integration of microalgae cultivation such as the wild strains Chlorella, Spirulinae in wastewater from cassava processing. The results showed a 92% reduction in chemical oxygen demand and were considered promising.

The process of making tucupi, a product obtained from cassava, testing the influence of different fermentation and cooking times on the reduction of microorganisms and on the levels of total and free cyanide in the product. The standardization of processing will guarantee safe levels of cyanide and microbiological quality for tucupi [6].

Brito [2] developed studies on the form of production, the physicochemical properties and the influence of fermentation on the production of biogenic amines and beta carotene in the production of tucupi sauce. The results showed that, although there are already recommendations for the standardization of tucupi sauce processing, it is not followed by the producers, with variations, mainly, in the fermentation and cooking stages.

Rheological behavior of tucupi sauce prepared with different concentrations (30%, 35%, and 40% solids) and concentration temperatures (50 °C, 70 °C and 90 °C), at temperatures in the range from 25 to 80°C, resulting in creamy tucupi, in powder and tablets. The rheological study showed that the concentration and concentration temperature influence its rheological behavior, since the gelatinization of the starch present in tucupi modifies the viscosity of the product. The creamy sauce with 10% tucupi was the most accepted, for which the purchase intention showed 1% of rejection of the product, followed by the broth in tablet with 20% of tucupi, had 98% of acceptance and the powder with 70 % of acceptance [10].

Brito et al [3] studied the influence of spontaneous fermentation of manipueira on bioactive amine and carotenoid profiles during tucupi production. Changes in physical-chemical and instrumental parameters, color, carotenoid profile and production of bioactive amines were evaluated during the production process in three phases: the first phase, up to 12 hours of fermentation; the second phase, from 16h to 24h, depending on the end of fermentation, and the third phase, the product was evaluated. Therefore, the results suggest the need for a precise control of manipueira fermentation to avoid or minimize the formation of biogenic amines.

The continuous production of surfactin and co-production of amylases and proteases by B. subtilis LB5a using cassava as a substrate at different dilution rates, with a view to reducing costs in the process and making better use of the microorganism's metabolic pathways. The biosurfactant was produced together with ten essential oils extracted from medicinal and aromatic plants and was tested for antimicrobial and antibiofilm activities [28].

The recovery steps and culture media in the production of biosurfactants by performing tests using ultrafiltration systems and cassava as. The results indicated good yields and purity of the surfactants produced with ultrafiltration and treatment of cassava with HCl pH2 with a recovery of 72% and 51.49% of purity [30].

Strains of Xanthomas spp. isolated from mango (Mangifera indica) leaf tissues for the production of xanthan gum in culture media using manipueira as a partial or total substitute for sucrose in the xanthan gum production process. The best formulation observed showed a manipueira:sucrose ratio of 100:0, thus demonstrating that this residue is viable to be used as a substitute for sucrose in processes for obtaining xanthan gum [14].

Silva et al [26] evaluate the effect of varying the concentration of manipueira as a substrate on the production of biomass and lipids by the yeast Rhodotorula mucilaginosa. Were test Three concentrations of manipueira in the culture medium were used: 50%, 75% and 100% and synthetic culture medium. The results indicated that the cultivation with 100% manipueira presented the best coefficient of conversion of reducing sugars in biomass and the cultivation in synthetic medium the best coefficient for lipids. However, the authors considered manipueira a good substrate for the growth of the yeast Rhodotorula mucilaginosa and for the production of lipids, and this

The changes caused by the development of Pleurotus ostreatus in cassava (Manihot esculenta) and sugar beet (Beta vulgaris) residues via solid state bioprocess (SSB) were evaluated in terms of variation in proximate composition, phenolic compounds, minerals, in vitro digestibility, growth fungal and lipase activity. This application has great biotechnological potential, for example, its use as a low-cost source of nutrients for animal feed [1].

The microbiological and physicochemical qualities of sour cassava starch and cassava bagasse produced in the cassava agroindustry. Yeast counts, coliforms and Bacillus cereus counts, as well as carbohydrate and dietary fiber contents were analyzed. The results indicated that cassava bagasse has a high content of dietary fiber and carbohydrates and can be used in food products [15].

The main components of orange pomace, cassava pomace and passion fruit peels and their digestibility in vitro. Cassava bagasse was mainly composed of starch, with high variability among the tested by-products (45–77.5% starch). In vitro experiments indicated that cassava bagasse had approximately 12% resistant starch. Concluding that cassava bagasse is a good source of fiber and has great potential for incorporation into various food products [29].

Czaikoski et al [11] produced and characterized cellulose nanofibers obtained from cassava husks with a combination of pre-treatments with acid hydrolysis or time-mediated oxidation and ultrasonic disintegration. The rheological and viscoelastic properties of the nanofibers were evaluated. The analysis of the results indicated its use as reinforcement for nanocomposites or as a thickening agent and that it is possible to adjust the mechanical properties of cellulose nanofibers by choosing and modifying the chemical and physical conditions of the process to allow a series of applications.

Travalini [29] used bagasse from the solid residues of cassava starch manufacturing to extract nanocrystalline cellulose (NCC) and nanofibrillated lignocellulose (LCNF) and incorporate them into starch films to replace commercial nanoparticles. The opacity, water absorption (AA) and water vapor permeability (PVA) of the films made with these nanoparticles were evaluated. The results showed that films developed with nanoparticles obtained from cassava bagasse showed interesting and competitive properties compared to commercial films.

Escarambonia et. al. [13] studied the biosynthesis of ethanol by rapid hydrolysis of cassava bagasse using fungal amylases produced by Rhizopus oligosporus in solid-state fermentation under optimized conditions. The amylase produced was applied in the proportion of 15 U/g of dry cassava bagasse to obtain cassava bagasse hydrolyzate that was later submitted to the fermentation process for ethanol production.

IV. CONCLUSIONS

The classification of the publications studied made it possible to identify four categories representative of research in the area of cassava starch that is not related to the theme of use of residues from the manufacturing process and seven categories representative of research related to the use of residues from the processing of starch of cassava.

The categorization made it possible to identify the themes with the greatest tendency to be published by area of study. Considering the total number of works analyzed, there was a higher incidence of research on topics dealing with obtaining cassava starch and the development of biodegradable films for covering fruits and vegetables. Considering only the publications that deal with residues from the processing of cassava starch, a predominance of publications that deal with products made from cassava bagasse is identified.

Regarding the areas with the lowest incidence of publication, the categories of physical and functional properties of cassava starch and residues from the manufacture of cassava starch have been highlighted, both with only one publication. scarcity of publications, presenting 02 articles each.

When analyzing and interpreting scientific publications, even if qualitatively, trends and opportunities for research development in less studied areas are highlighted. It is demonstrated that this analysis is decisive in the decision-making cycles in scientific research.

Finally, it is considered that this work met the proposed objectives, not having, however, the intention of exhausting the discussion of the subject, being of great value the development of other works that approach the scientific research on the residues of the manufacture of the starch of manioc.

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