REPORTE DE CASO

Chromoendoscopy innovation: Could purple corn solution be a potential natural contrast agent for detecting colonic lesions?

Innovación en cromoendoscopia: ¿podría la solución de maíz morado ser un posible agente de contraste natural para la detección de lesiones colónicas?

Gustavo Kishimoto[1,2], **Tamy Yamamoto**[1]

[1] Clínica Centenario Peruano Japonesa, Lima, Perú.
[2] Policlínico Peruano Japonés, Lima, Perú.

Received: 20/01/2025
Accepted: 21/05/2025
Online: 30/06/2025

Author contribution
All authors were involved in the conceptualization, supervision, validation, writing of the original draft, and critical review and editing.

Conflict of interest
Gustavo Kishimoto is a paid consultant for AWMedical and Olympus Corporation of the Americas, its subsidiaries and/or affiliates. Tamy Yamamoto declares no conflict of interest.

Funding
No specific funding was received for this article from public, commercial, or not-for-profit agencies.

Cite as
Kishimoto G, Yamamoto T. Chromoendoscopy innovation: Could purple corn solution be a potential natural contrast agent for detecting colonic lesions? Rev Gastroenterol Peru. 2025;45(2):176-9. doi: 10.47892/rgp.2025.452.1875.

ABSTRACT
Peru has a high incidence and mortality rate of stomach and colorectal cancers. While chromoendoscopy (CE) with indigo carmine dye is the gold standard for gastrointestinal tumor early detection, its accessibility is limited in Peru due to cost and infrastructure restrictions. This study explores the potential of a natural alternative: anthocyanin dye extracted from purple corn (PC), a widely consumed and accessible food source in Peru. A PC decoction was prepared by boiling the PC and adjusting the pH to 8. A 38-year-old male patient underwent colonoscopy, finding a rectal polyp followed by CE with both IC and PC solution (PCS). The PCS effectively stained the colonic mucosa, allowing for visualization of the lesion. In this report, PCS is presented as a potential cost-effective and readily available natural contrast agent for CE, particularly relevant for low-resource environments in Peru. Further research and collaboration are needed to address standardization and staining duration for more reliable and accurate results.
Keywords: *Endoscopy; Zea mays; Anthocyanins; Early Detection of Cancer; Staining and Labeling (source: MeSH NLM).*

RESUMEN
Perú tiene una alta incidencia y tasa de mortalidad por cáncer de estómago y colorrectal. Si bien la cromoendoscopia (CE) con índigo carmín es el gold standard para la detección temprana de tumores gastrointestinales, en Perú, su accesibilidad es limitada debido a restricciones de costo e infraestructura. Este estudio explora el potencial de una alternativa natural: el colorante de antocianina extraído del maíz morado (MM), un alimento ampliamente consumido y accesible en Perú. Se preparó una solución mediante la decocción de MM y se ajustó el pH a 8. Se realizó una colonoscopia a un paciente varón de 38 años, y se encontró un pólipo rectal. Se procedió a realizar CE con índigo carmín y solución de MM (SMM). La SMM tiñó eficazmente la mucosa colónica, permitiendo la visualización de la lesión. En este reporte, la SMM se presenta como un potencial agente de contraste natural, económico y fácilmente disponible para la CE, particularmente relevante en entornos de bajos recursos en Perú. Sería importante realizar más investigación para abordar la estandarización y la duración de la tinción para obtener resultados más fiables y precisos.
Palabras clave: *Endoscopía; Zea mays; Antocianinas; Detección Precoz del Cáncer; Coloración y Etiquetado (fuente: DeCS Bireme).*

INTRODUCTION

Peru emerged as a regional leader in 2022, with the highest stomach cancer incidence and the third-highest mortality rate. This troubling trend extends to colorectal cancer (CRC), currently ranking 13th in incidence within the region but exhibiting a concerning annual increase. This illustrates a clear image of a growing public health problem in Peru [(1)].

Since 1991, Peru has implemented diverse strategies (medical access, public awareness, screening programs, and health policies) against various cancers, achieving encouraging results [(2)]. However, a dedicated state policy for early detection and timely treatment of incipient oncological conditions remains uncertain.

Chromoendoscopy (CE) or endoscopic tissue staining involves the use of different types of dyes to better characterize, delineate, or highlight specific

Correspondencia:
Gustavo Kishimoto
Av. Gregorio Escobedo 783, Jesús María
15076 Policlínico Peruano Japonés - Cuerpo Médico
Telephone: +965-422-423
E-mail: gustavokishimoto@gmail.com

gastrointestinal findings [3]. In stomach and bowels, indigo-carmine (IC) dye is the gold standard stain [4]. This dye is derived from indigo, which is a blue plant dye from genus Indigofera [5], and carmine, a red coloring agent extracted from cochineal eggs (*Coccus cacti*, now called *Dactylopius coccus*), a tropical arachnida mainly from Peru [6].

IC dye is not absorbed when applied topically on the gastrointestinal tract; therefore, it is used as a standardized contrast solution in chromoendoscopy, as it accentuates and highlights irregularities in the mucosal surface and is most commonly used to improve adenoma rate detection [7].

Emerging digital CE technologies utilize sophisticated light source manipulation, enabling the selective targeting of specific wavelengths to achieve an effect analogous to chromoendoscopy. This approach offers the potential to enhance the visualization of subtle lesion features, transforming the landscape of endoscopic diagnosis. Currently, enhanced image endoscopy (IEE) with optical filters is the gold standard for the detection of gastrointestinal (GI) tract tumors [8].

Despite the immense potential of AI-powered CE (IC/IEE) for early detection of gastrointestinal malignancies, Peru's budgetary constraints limit its accessibility in numerous regions. This limitation hinders proper endoscopic training, consequently hampering the battle against this critical public health concern [9].

Leveraging this adversity to drive breakthrough solutions, Peru may have an innovative, low-cost, and accessible tool for early cancer detection. A natural alternative could overcome those limitations, enabling timely diagnosis for the population.

In Peru, there are various kinds of corn with different colors such as white, yellow, red, purple, gray. Purple corn (PC) has been cultivated mainly in Peru, and it has been used in the diet of Peruvians since the ancestors of the Incas [10]. The PC's dense color is due to anthocyanin. This dye is widely accepted and used in staining food, beverages, jellies, and candies in several countries [11]. Likewise, some studies recognize the benefits of anthocyanin against CRC [12]. Thus, the anthocyanin from PC is easily accessible and cheap in Peru, where it is widely consumed, for example, in the form of chicha morada, a Peruvian traditional soft drink, made with simmered PC and some spices. This may provide a cost-effective alternative to indigo-carmine CE and IEE, allowing for broader use of CE in resource-limited settings. Especially considering the striking economic disparity between medical-grade sterile IC and PC, where a 6 ml-vial of IC could cost about the same as preparing 5000 mL of PC solution (PCS).

This study reports the use of simmered PCS as a natural contrast dye in CE to enhance colonic mucosa to better visualize defects or tumors compared with IC.

CASE REPORT

PCS preparation

One kilogram of purple corn was rinsed under cold water to remove dirt and impurities. The kernels were gently rubbed by hand to remove any remaining residue. Following this hygiene step, the kernels were separated from the cob. Both the kernels and the cob were then placed in a large pot with 1 liter of water and brought to a boil. The temperature was then lowered, and the mixture simmered for 1 hour or until the water volume was reduced by half. The liquid was then filtered through a fine-mesh strainer to remove the kernels and cob, and it was allowed to cool at room temperature. Subsequently, a precisely measured teaspoon of sodium bicarbonate was added to achieve a target pH of 8, resulting in a purple-black colored solution (Figure 1). Owing to the absence of preservatives inherent in this artisanal preparation, refrigeration of the resultant PCS, similar to chicha morada, was mandatory until use.

Chromoendoscopy with PCS

A 38-year-old male Peruvian patient presented to the office with a 3-month history of dyspepsia, reflux, nausea, cramps, bloating, and diarrhea without mucus or blood.

Figure 1. Comparison between IC (left) and PCS (right).

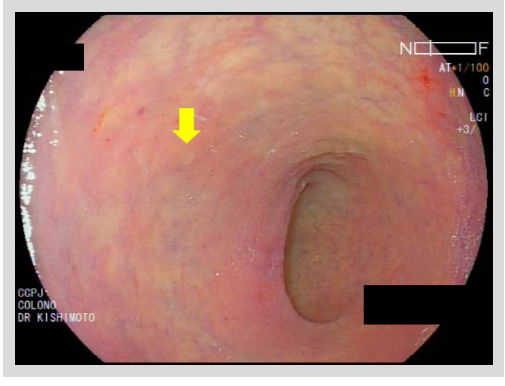

Figure 2. A 3 mm 0-Is non-neoplastic polyp by LCI (yellow arrow).

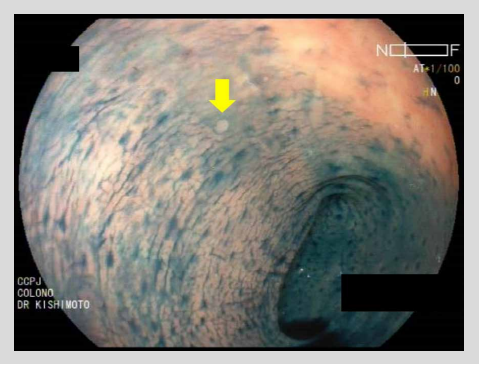

Figure 3. Same 3 mm-polyp with IC dye spraying in WLE (yellow arrow).

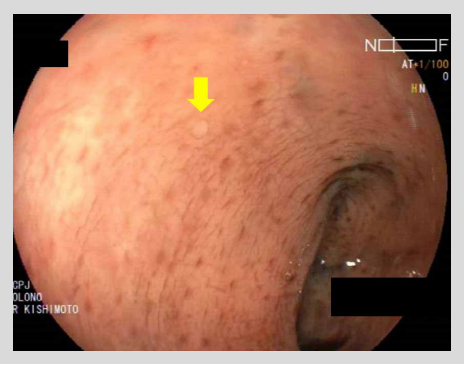

Figure 4. Lesion with PCS dye spraying in WLE (yellow arrow).

He reported a moderate to severe colic in the right hypochondrium with radiation to the back after a large meal, which was the reason for his consultation. Physical examination revealed a soft, depressible, distended abdomen with increased bowel sounds, tympanic, without visceromegaly or tenderness to palpation, and no rebound sign. In light of an unremarkable abdominal ultrasound, a colonoscopy was recommended considering the patient's family history of pancreatic cancer.

Following colon preparation with 5 liters of polyethylene glycol (PEG) and without encountering any adverse events, a satisfactory bowel cleansing was achieved, as evidenced by a Boston score of 9. The patient, who had drunk chicha morada since childhood, and was well aware about the risks of colonoscopy and CE with IC and the PCS preparation; signed informed consent and underwent colonoscopy with sedation provided by an anesthesiologist. Five minutes after the procedure began, the cecum was reached without complications. The ascending colon, hepatic flexure, transverse colon, and splenic flexure were carefully observed in retroflexion, with no significant findings. After returning to the cecum again, a fold-by-fold inspection was performed in frontal view until a 3 mm elevated lesion was found in the rectum (10 cm from the anal margin). Figure 2 shows a 0-Is non-neoplastic polyp by linked color imaging (LCI) endoscopy.

After adequate surface rinsing with water, the lesion was clearly distinguished with IC dye spraying in white light endoscopy (WLE) (Figure 3), with a Kudo pit pattern II [13].

Following adequate IC washout, PCS spraying was performed, and the lesion became distinctly delineated (Figure 4) in WLE, identifying the same pit pattern.

Figures 5 and 6 show PCS with LCI and blue laser imaging (BLI). The pathology report confirmed it to be a hyperplastic rectal polyp.

The patient tolerated the procedure well, without any adverse reactions to the contrast agents or sedation.

Ethical considerations

This research was conducted with the informed consent of the participating patient, following authorization from the Management Committee of the Clínica Centenario Peruano Japonesa (Letter N°072-2024/G-CCPJ) and approval from the Ethics Committee of Universidad Continental (Oficio N°0869-2024-CIEI-UC).

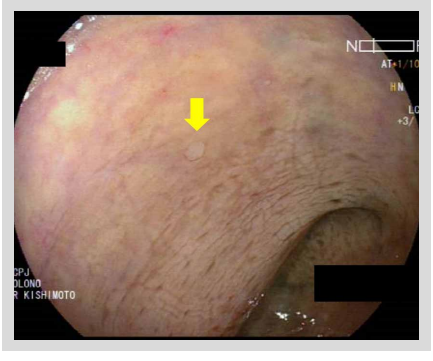

Figure 5. Lesion with PCS dye spraying in LCI (yellow arrow).

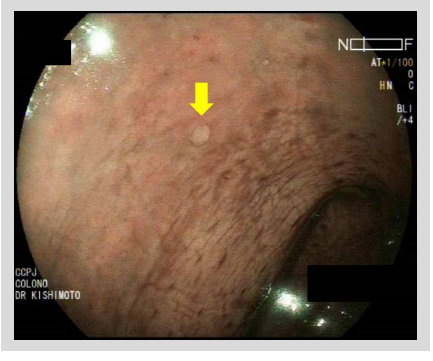

Figure 6. Lesion with PCS dye spraying in BLI (yellow arrow).

 https://doi.org/10.47892/rgp.2025.452.1875

DISCUSSION

This case report presents the novel use of purple corn solution (PCS), a traditional Peruvian beverage, as a contrast agent in chromoendoscopy (CE) for the detection of gastrointestinal lesions. While indigo carmine (IC) remains the gold standard for chromoendoscopy, our findings suggest that PCS may offer a safe and cost-effective alternative, particularly in developing countries like Peru.

While IC is widely used, it is important to remain mindful of potential adverse events, such as hypertension, skin irritation, and edema. This should be taken into consideration, particularly when larger volumes are used for gastrointestinal cancer screening. This contrasts with PCS, which is safely consumed in large quantities [14].

While high-definition endoscopy with virtual CE provides advanced imaging capabilities, IC-CE remains a highly effective and cost-efficient method for detecting small colonic polyps, even with standard-definition equipment [15,16]. Similarly, PCS-CE (with white light endoscopy) offers a promising, low-cost alternative for enhancing polyp detection, particularly in resource-constrained environments where access to advanced endoscopic technologies may be limited. The affordability and accessibility of PCS could significantly increase the utilization of CE, thereby improving the early detection of gastrointestinal neoplasia.

Standardization of the PCS preparation and determination of the optimal staining duration warrant further investigation to ensure reliable and accurate results. A comparative study of PCS and IC, assessing lesion visualization, contrast enhancement, and mucosal crypt staining, is needed. Furthermore, larger controlled trials are required to validate these findings and evaluate the efficacy and safety of PCS compared to IC.

The authors believe that continued research and collaborative efforts will address the remaining challenges associated with PCS, allowing this customary drink to improve endoscopic cancer screening, particularly in resource-limited communities, such as those in rural Peru. It is hoped that this innovation will inspire further exploration of locally sourced natural dyes, expanding options for enhanced lesion detection and contributing to the early diagnosis and timely treatment of gastrointestinal cancers worldwide.

Acknowledgments

The Nippon Foundation Nikkei Scholarship.

REFERENCES

1. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2022. CA Cancer J Clin. 2022;72(1):7-33. doi: 10.3322/caac.21708.
2. Santos E. Current approaches to gastric cancer in Peru and Mexico. Transl Gastroenterol Hepatol. 2017;2:55. doi: 10.21037/tgh.2017.05.06.
3. Acosta MM, Boyce HW Jr. Chromoendoscopy--where is it useful? J Clin Gastroenterol. 1998;27(1):13-20. doi: 10.1097/00004836-199807000-00005.
4. Fujii T, Hasegawa RT, Saitoh Y, Fleischer D, Saito Y, Sano Y, Kato S. Chromoscopy during colonoscopy. Endoscopy. 2001;33(12):1036-41. doi: 10.1055/s-0036-1588009.
5. Campos JKL, Araújo TFDS, Brito TGDS, da Silva APS, da Cunha RX, Martins MB, *et al.* Indigofera suffruticosa Mill. (Anil): Plant Profile, Phytochemistry, and Pharmacology Review. Adv Pharmacol Sci. 2018;2018:8168526. doi: 10.1155/2018/8168526.
6. Roque-Rodríguez FJ. Controlled Mass Rearing of Cochineal Insect (Hemiptera: Dactylopiidae) Using Two Laboratory-Scale Production Systems in Peru. J Insect Sci. 2022;22(1):1. doi: 10.1093/jisesa/ieab098.
7. Kahi CJ, Anderson JC, Waxman I, Kessler WR, Imperiale TF, Li X, *et al.* High-definition chromocolonoscopy vs. high-definition white light colonoscopy for average-risk colorectal cancer screening. Am J Gastroenterol. 2010;105(6):1301-7. doi: 10.1038/ajg.2010.51.
8. Bond A, Sarkar S. New technologies and techniques to improve adenoma detection in colonoscopy. World J Gastrointest Endosc. 2015;7(10):969-80. doi: 10.4253/wjge.v7.i10.969.
9. Kudo SE, Mori Y, Misawa M, Takeda K, Kudo T, Itoh H, *et al.* Artificial intelligence and colonoscopy: Current status and future perspectives. Dig Endosc. 2019;31(4):363-371. doi: 10.1111/den.13340.
10. Salvador-Reyes R, Clerici MTPS. Peruvian Andean maize: General characteristics, nutritional properties, bioactive compounds, and culinary uses. Food Res Int. 2020;130:108934. doi: 10.1016/j.foodres.2019.108934.
11. Chatham LA, Paulsmeyer M, Juvik JA. Prospects for economical natural colorants: insights from maize. Theor Appl Genet. 2019;132(11):2927-2946. doi: 10.1007/s00122-019-03414-0.
12. Shi N, Chen X, Chen T. Anthocyanins in Colorectal Cancer Prevention Review. Antioxidants (Basel). 2021;10(10):1600. doi: 10.3390/antiox10101600.
13. Kudo S, Tamura S, Nakajima T, Yamano H, Kusaka H, Watanabe H. Diagnosis of colorectal tumorous lesions by magnifying endoscopy. Gastrointest Endosc. 1996;44(1):8-14. doi: 10.1016/s0016-5107(96)70222-5.
14. Ristea ME, Zarnescu O. Indigo Carmine: Between Necessity and Concern. J Xenobiot. 2023;13(3):509-528. doi:10.3390/jox13030033.
15. Longcroft-Wheaton G, Brown J, Cowlishaw D, Higgins B, Bhandari P. High-definition vs. standard-definition endoscopy with indigo carmine for the in vivo diagnosis of colonic polyps. United European Gastroenterol J. 2013;1(6):425-9. doi: 10.1177/2050640613502963.
16. Fu KI, Sano Y, Kato S, Fujii T, Nagashima F, Yoshino T, *et al.* Chromoendoscopy using indigo carmine dye spraying with magnifying observation is the most reliable method for differential diagnosis between non-neoplastic and neoplastic colorectal lesions: a prospective study. Endoscopy. 2004;36(12):1089-93. doi: 10.1055/s-2004-826039.